PC-HELPER

100KSPS 12-bit Analog I/O Board for PCI Express

AIO-121601E3-PE

100KSPS 16-bit Analog I/O Board for PCI Express

AIO-161601E3-PE

1MSPS 12-bit Analog I/O Board for PCI Express

AIO-121601UE3-PE

1MSPS 16-bit Analog I/O Board for PCI Express

AIO-161601UE3-PE

User's Guide

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

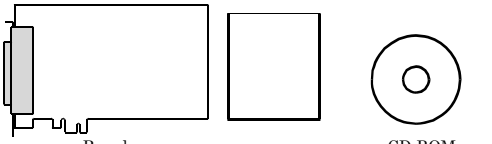
The product consists of the items listed below.

Check, with the following list, that your package is complete. If you discover damaged or missing items, contact your retailer.

Product Configuration List

- Board (One of the following) …1
  [AIO-121601E3-PE, AIO-161601E3-PE, AIO-121601UE3-PE or AIO-161601UE3-PE]
- First step guide …1
- CD-ROM *1 [API-PAC(W32)]…1

*1 The CD-ROM contains the driver software and User's Guide (this guide)



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1. Before Using the Product

About the Board

This product is an unisolated PCI Express bus-compliant interface board that expands the I/O function of a PC for analog signals.
This product carries high-capacity buffer memory for 16M data for analog input, allowing background sampling to be performed in a variety of trigger conditions.
This product also has one analog output channel, four channels for TTL level digital input, and four channels for TTL level digital output.

The product lineup consists of four models, depending on the combination of the resolution of the analog input block (12-bit or 16-bit) and the conversion speed (10μsec/ch or 1μsec/ch). Using specially designed accessories allows you to expand functions such as additional channels, simultaneous sampling and isolation amplifier. It is bundled with full-fledged software "C-LOGGER".

The product can also be used as a data recording device for MATLAB and LabVIEW, using dedicated libraries as plug-ins.

Features

- Available in four models depending on the resolution (12-bit or 16-bit) and combination of conversion speed (10μsec/ch or 1μsec/ch).

The < AIO-121601E3-PE > is the type that performs A-D conversion at a conversion speed of 10μ sec/ch and a resolution of 12-bit.
The < AIO-161601E3-PE > is the high-precision type that performs A-D conversion at a conversion speed of 10μ sec/ch and a resolution of 16-bit.
The < AIO-121601UE3-PE > is the high-speed type that performs A-D conversion at a conversion speed of 1μ sec/ch and a resolution of 12-bit.
The < AIO-161601UE3-PE > is the high-speed, high-precision type that performs A-D conversion at a conversion speed of 1μsec per channel and a resolution of 16-bit.

The product has analog input 16ch, analog output 1ch, digital input/output (TTL level: four each), and a counter (32-bit, TTL level 1ch). In addition, the analog input can be set to single-end input 16ch or differential input 8ch, while the counter is commonly used as the digital input/output.

- Equipped with mass-storage buffer memory (16M data) that can be used in the FIFO or RING format

The analog input block contains mass-storage buffer memory (16M data) that can be used in the FIFO or RING format. This allows for background analog input that does not depend on the operation status of the software or PC.

- A variety of accessories are available for function expansion.

A number of accessories are available to expand the functions even further: a buffer amplifier, simultaneous sampling, isolation and current/thermocouple input, a low-pass filter, additional channels (+ 16ch), cables, etc.

- Bundled with data logger software and Windows/Linux driver libraries

Using the bundled data logger software "C-LOGGER" allows you to display recorded signal data in graphs, perform zoom measurement, save files, and perform dynamic transfer of data to the spreadsheet software "Excel" without any special program. In addition, the product is bundled with the driver library API-PAC(W32) which can be used to create various Windows/Linux applications as well as a diagnostic program which can be used to check the hardware operation.

- The start/end of sampling can be controlled by software, comparison of conversion data, an external trigger, etc.

You can select from software, comparison of conversion data or an external trigger (timing of an externally input control signal) to control the start of sampling.

you can select from completion of sampling for a specified number of sessions, comparison of conversion data, an external trigger or software to control the end of sampling.

The sampling cycle can be selected from the internal clock (high-precision timer mounted on the board) or an external clock (externally input control signal).

- Supporting MATLAB and LabVIEW using dedicated libraries as plug-ins

Using dedicated libraries allows you to create various MATLAB and LabVIEW applications.

- Software-based calibration function

Calibration of analog input/output can be all performed by software. Apart from the adjustment information prepared before shipment, additional adjustment information can be stored according to the use environment.

Support Software

You should use CONTEC support software according to your purpose and development environment.

Windows version of analog I/O driver **API-AIO(WDM)/API-AIO(98/PC)**
[Stored on the bundled CD-ROM driver library API-PAC(W32)]

The API-AIO(WDM)/API-AIO(98/PC) is the Windows version driver library software that provides products in the form of Win32 API functions (DLL). Various sample programs such as Visual Basic and Visual C++, etc and diagnostic program useful for checking operation is provided.

< Operating environment >

OS	Windows Vista, XP, Server 2003, 2000
Adaptation language	Visual Basic, Visual C++, Visual C#, Delphi, C++ Builder

You can download the updated version from the CONTEC's Web site (http://www.contec.com/apipac/). For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

Linux version of analog I/O driver **API-AIO(LNX)**
[Stored on the bundled CD-ROM driver library API-PAC(W32)]

The API-AIO(LNX) is the Linux version driver software which provides device drivers (modules) by shared library and kernel version. Various sample programs of gcc are provided.

< Operating environment >

OS	RedHatLinux, TurboLinux (For details on supported distributions, refer to Help available after installation.)
Adaptation language	gcc

You can download the updated version from the CONTEC's Web site (http://www.contec.com/apipac/). For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

Data Logger Software **C-LOGGER**
[Stored on the bundled CD-ROM driver library API-PAC(W32)]

C-LOGGER is a data logger software program compatible with our analog I/O products. This program enables the graph display of recorded signal data, zoom observation, file saving, and dynamic transfer to the spreadsheet software "Excel". No troublesome programming is required.

CONTEC provides download services (at http://www.contec.com/clogger) to supply the updated drivers.

For details, refer to the C-LOGGER Users Guide or our website.

< Operating Environment >

OS	Windows Vista, XP, Server 2003, 2000

Data acquisition VI library for LabVIEW **VI-DAQ** (Available for downloading (free of charge) from the CONTEC web site.)

This is a VI library to use in National Instruments LabVIEW.
VI-DAQ is created with a function form similar to that of LabVIEW's Data Acquisition VI, allowing you to use various devices without complicated settings.
See http://www.contec.com/vidaq/ for details and download of VI-DAQ.

Data Acquisition library for MATLAB **ML-DAQ** (Available for downloading (free of charge) from the CONTEC web site.)

This is the library software which allows you to use our analog I/O device products on MATLAB by the MathWorks. Each function is offered in accordance with the interface which is integrated in MATLAB's Data Acquisition Toolbox.
See http://www.contec.com/mldaq/ for details and download of ML-DAQ.

Cable & Connector (Option)

< For analog I/O >

Flat Cable with One 37-pin D-Type Connector	:	PCA37P-1.5 (1.5m)
Shielded Cable with One 37-pin D-Type Connector	:	PCA37PS-0.5P (0.5m)
	:	PCA37PS-1.5P (1.5m)
Shielded Cable with Two 37-pin D-Type Connectors	:	PCB37PS-0.5P (0.5m)
	:	PCB37PS-1.5P (1.5m)
Flat Cable with Two 37-pin D- SUB Connectors	:	PCB37P-1.5 (1.5m)
Coaxial Cable for Single-ended Inputs	:	PCC16PS-1.5 (1.5m)
	:	PCC16PS-3 (3m)
2 Wires Shielded Cable for Differential Inputs	:	PCD8PS-1.5 (1.5m)
	:	PCD8PS-3 (3m)

< For digital I/O >

Flat Cable with One 15-pin D-Type Connector	:	PCA15P-1.5 (1.5m)
Flat Cable with Two 15-pin D-Type Connectors	:	PCB15P-1.5 (1.5m) *1*2
Flat Cable with 1 Sided 16-Pin Header Connector (1.5m)	:	DT/E1
Conversion Cable (16-Pin to 15-Pin) with Bracket (100mm)	:	DT/E2
Conversion Cable (16-Pin to 15-Pin) with Bracket (150mm)	:	DT-E3

< Connector >

D-SUB37P Male Connector Set (5pieses)	:	CN5-D37M

*1 DT/E2 required

*2 For FTP-15 only

Accessories (Option)

Termination panel with Screw Terminals for Spade Lugs : DTP-3A *3
Termination panel with Screw Terminals : DTP-4A *3
Termination panel with BNC connectors for Analog Multi-function Boards
: ATP-16E *3
Buffer amplifier termination panel for analog multi-function box
: ATBA-16E *3
Termination panel for Digital I/O on Analog Multi-function Boards
: FTP-15 *4
Screw Terminal : EPD-37A *3*5
Screw Terminal : EPD-37 *3
16 Channel Simultaneous Sample & Hold Accessory : ATSS-16A *3*6
8ch-Isolation Accessory Board for Analog Inputs : ATII-8C *3
8ch Gain Operation Amplifier Accessory Board for Analog Input
: ATLF-8A *3
16CH Multiplexer Sub-Board for AIO-121601E3-PE and AIO-161601E3-PE
: ATCH-16A(PCI)
16CH Multiplexer Sub-Board for AIO-121601UE3-PE and AIO-161601UE3-PE
: ATUH-16A(PCI)

*3 A PCB37PS -*P optional cable is required separately. (0.5m is recommended.)
*4 A DT/E2 and PCB15P-1.5 optional cable is required separately.
*5 ”Screw upright terminal panel” is used to prevent terminal screws from falling off.
*6 A separate external power supply is required.

* Check the CONTEC’s Web site for more information on these options.

Customer Support

CONTEC provides the following support services for you to use CONTEC products more efficiently and comfortably.

Web Site

Japanese http://www.contec.co.jp/
English http://www.contec.com/
Chinese http://www.contec.com.cn/

Latest product information

CONTEC provides up-to-date information on products.

CONTEC also provides product manuals and various technical documents in the PDF.

Free download

You can download updated driver software and differential files as well as sample programs available in several languages.

Note! For product information
Contact your retailer if you have any technical question about a CONTEC product or need its price, delivery time, or estimate information.

Limited Three-Years Warranty

CONTEC products are warranted by CONTEC CO., LTD. to be free from defects in material and workmanship for up to three years from the date of purchase by the original purchaser.

Repair will be free of charge only when this device is returned freight prepaid with a copy of the original invoice and a Return Merchandise Authorization to the distributor or the CONTEC group office, from which it was purchased.

This warranty is not applicable for scratches or normal wear, but only for the electronic circuitry and original boards. The warranty is not applicable if the device has been tampered with or damaged through abuse, mistreatment, neglect, or unreasonable use, or if the original invoice is not included, in which case repairs will be considered beyond the warranty policy.

How to Obtain Service

For replacement or repair, return the device freight prepaid, with a copy of the original invoice. Please obtain a Return Merchandise Authorization number (RMA) from the CONTEC group office where you purchased before returning any product.

* No product will be accepted by CONTEC group without the RMA number.

Liability

The obligation of the warrantor is solely to repair or replace the product. In no event will the warrantor be liable for any incidental or consequential damages due to such defect or consequences that arise from inexperienced usage, misuse, or malfunction of this device.

Safety Precautions

Understand the following definitions and precautions to use the product safely.

Safety Information

This document provides safety information using the following symbols to prevent accidents resulting in injury or death and the destruction of equipment and resources. Understand the meanings of these labels to operate the equipment safely.

⚠ DANGER	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

Handling Precautions

⚠ DANGER

Do not use the product where it is exposed to flammable or corrosive gas. Doing so may result in an explosion, fire, electric shock, or failure.

⚠ CAUTION

- There are switches and jumpers on the board that need to be set in advance.
  Be sure to check these before installing the board.
- Only set the switches and jumpers on the board to the specified settings.
  Otherwise, the board may malfunction, overheat, or cause a failure.
- Do not strike or bend the board.
  Otherwise, the board may malfunction, overheat, cause a failure or breakage.
- Do not touch the board's metal plated terminals (edge connector) with your hands.
  Otherwise, the board may malfunction, overheat, or cause a failure.
  If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
- Do not plug or unplug the cables which are connected to the board while the PC or expansion unit is still turned on.
  Otherwise, the board may malfunction, overheat, or cause a failure.
  Be sure that the personal computer power is turned off.
- Do not install or remove the board to or from the expansion slot while the computer's power or expansion unit is turned on.
  Otherwise, the board may malfunction, overheat, or cause a failure.
  Be sure that the personal computer power is turned off.
- Make sure that your PC or expansion unit can supply ample power to all the boards installed.
  Insufficiently energized boards could malfunction, overheat, or cause a failure.
- The specifications of this product are subject to change without notice for enhancement and quality improvement.
  Even when using the product continuously, be sure to read the manual and understand the contents.
- Do not modify the product. CONTEC will bear no responsibility for any problems, etc., resulting from modifying this product.
- Regardless of the foregoing statements, CONTEC is not liable for any damages whatsoever (including damages for loss of business profits) arising out of the use or inability to use this CONTEC product or the information contained herein.

Environment

Use this product in the following environment. If used in an unauthorized environment, the board may overheat, malfunction, or cause a failure.

Operating temperature

0 - 50°C

Operating humidity

10 - 90%RH (No condensation)

Corrosive gases

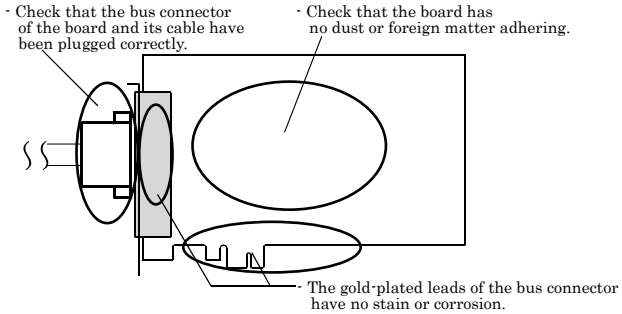
None

Floating dust particles

Not to be excessive

Inspection

Inspect the product periodically as follows to use it safely.


- Check that the bus connector of the board and its cable have been plugged correctly.
- Check that the board has no dust or foreign matter adhering.
- The gold-plated leads of the bus connector have no stain or corrosion.

Storage

When storing this product, keep it in its original packing form.

(1) Put the board in the storage bag.
(2) Wrap it in the packing material, then put it in the box.
(3) Store the package at room temperature at a place free from direct sunlight, moisture, shock, vibration, magnetism, and static electricity.

Disposal

When disposing of the product, follow the disposal procedures stipulated under the relevant laws and municipal ordinances.

2. Setup

This chapter explains how to set up the board.

What is Setup?

Setup means a series of steps to take before the product can be used.
Different steps are required for software and hardware.
The setup procedure varies with the OS and applications used.

Using the Board under Windows

Using the Driver Library API-PAC(W32)

This section describes the setup procedure to be performed before you can start developing application programs for the board using the bundled CD-ROM "Driver Library API-PAC(W32)".

Taking the following steps sets up the software and hardware. You can use the diagnosis program later to check whether the software and hardware function normally.

Step 1 Installing the Software

Step 2 Setting the Hardware

Step 3 Installing the Hardware

Step 4 Initializing the Software

Step 5 Checking Operations with the Diagnosis Program

If Setup fails to be performed normally, see the "Setup Troubleshooting" section at the end of this chapter.

Using the Board under Windows

Using Software Other than the Driver Library API-PAC(W32)

For setting up software other than API-PAC(W32), refer to the manual for that software. See also the following parts of this manual as required.

This chapter Step 2 Setting the Hardware

This chapter Step 3 Installing the Hardware

Chapter 3 External Connection

Chapter 6 About Hardware

Using the Board under an OS Other than Windows

For using the board under Linux, see the following parts of this manual.

This chapter Step 2 Setting the Hardware

Chapter 3 External Connection

Chapter 5 About Software

Chapter 6 About Hardware

For using the board under an OS other than Windows, Linux, see the following parts of this manual.

This chapter Step 2 Setting the Hardware

Chapter 3 External Connection

Chapter 6 About Hardware

Step 1 Installing the Software

This section describes how to install the API function libraries.

Before installing the hardware on your PC, install the Driver libraries from the bundled API-PAC(W32) CD-ROM.

The following description assumes the operating system as Windows XP. Although some user interfaces are different depending on the OS used, the basic procedure is the same.

About the Driver

There are the two drivers "API-AIO(WDM)" and "API-AIO(98/PC)" among the analog input/output drivers.

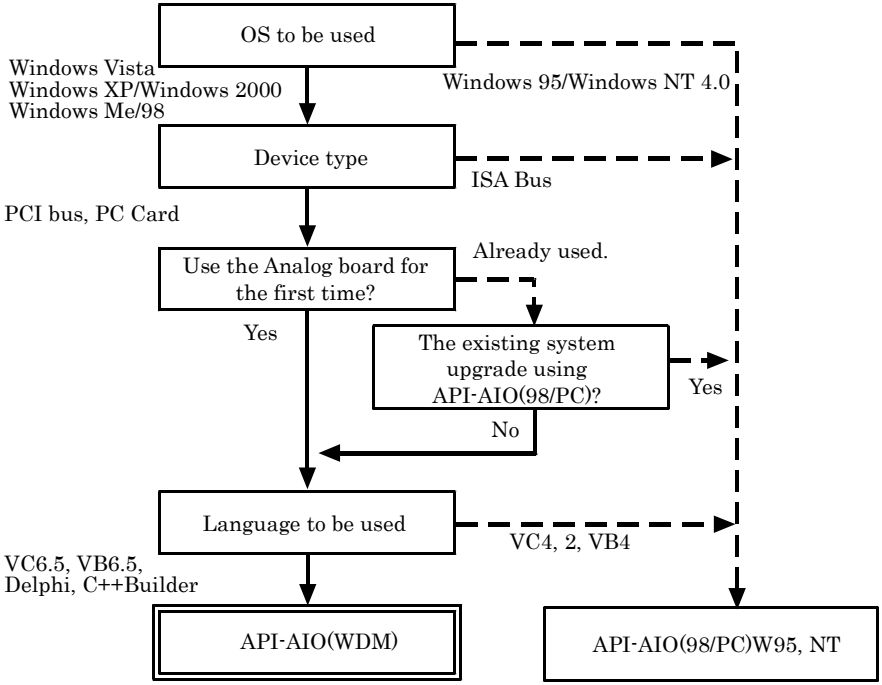
API-AIO(WDM) is a new driver to perform analog input and output under Windows.

It was developed aiming at "more easily use and more convenient" "more high performance" corresponding to the product version of API-AIO(98/PC) so far.

When using an analog input/output device, we recommend you use API-AIO(WDM). Although API-AIO(WDM) is designed to correspond with future new OS and new device, it is not suitable for Windows NT 4.0 or Windows 95 and ISA Bus.

As a result, please use API-AIO(98/PC) under these environments.

Here introduces the selection guide that can help choose the available drivers easily.

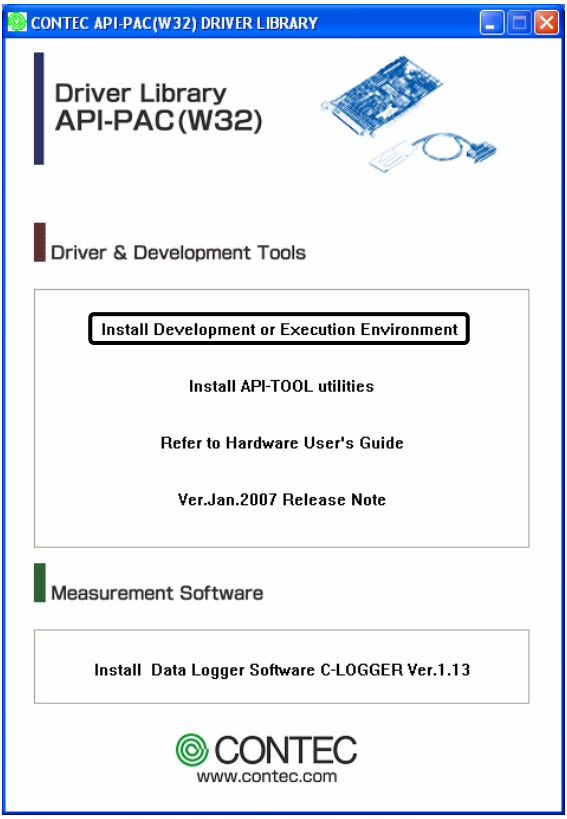


Starting the Install Program

(1) **Load the CD-ROM [API-PAC(W32)] on your PC.**

(2) **The API-PAC(W32) Installer window appears automatically.**
If the panel does not appear, run (CD-ROM drive letter):\AUTORUN.exe.

(3) **Click on the [Install Development or Execution Environment] button.**



* When using the Windows Vista, driver is automatically installed.

⚠ CAUTION

Before installing the software in Windows Vista, XP, Server 2003, 2000, or NT, log in as a user with administrator privileges.

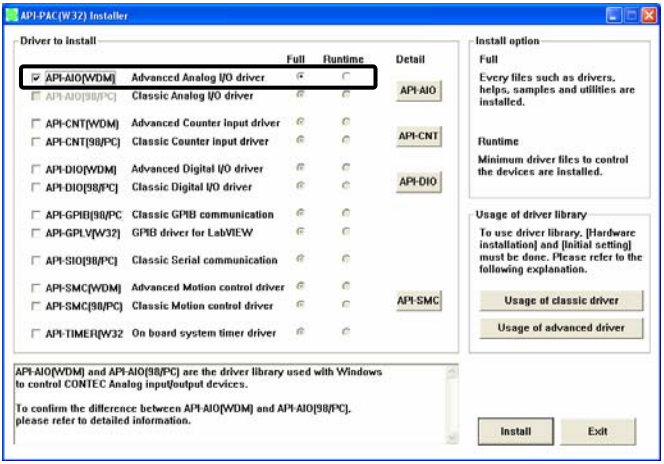
Select API-AIO(WDM)

Select API-AIO(WDM)

(1) **The following dialog box appears to select "Driver to install" and "Install option", "Usage of driver library".**

(2) **Select the "High Functionality WDM Analog I/O driver".**

(3) **Click on the [Install] button.**


API-PAC(W32) Installer
Driver to install
Full
Runtime
Detail
API-AIO[WDM] Advanced Analog I/O driver
API-AIO[98/PC] Classic Analog I/O driver
API-AIO
API-CNT[WDM] Advanced Counter input driver
API-CNT[98/PC] Classic Counter input driver
API-CNT
API-DIO[WDM] Advanced Digital I/O driver
API-DIO[98/PC] Classic Digital I/O driver
API-DIO
API-GPIB[98/PC Classic GPIB communication
API-GPLV[W32] GPIB driver for LabVIEW
API-SIO[98/PC] Classic Serial communication
API-SMC[WDM] Advanced Motion control driver
API-SMC[98/PC] Classic Motion control driver
API-SMC
API-TIMER[W32 On board system timer driver
Install option
Full
Every files such as drivers, helps, samples and utilities are installed.
Runtime
Minimum driver files to control the devices are installed.
Usage of driver library
To use driver library, [Hardware installation] and [Initial setting] must be done. Please refer to the following explanation.
Usage of classic driver
Usage of advanced driver
API-AIO[WDM] and API-AIO[98/PC] are the driver library used with Windows to control CONTEC Analog input/output devices.
To confirm the difference between API-AIO[WDM] and API-AIO[98/PC], please refer to detailed information.
Install
Exit

* Clicking on the [API-AIO] button under the "Detail" displays detailed information about API-AIO(WDM) and API-AIO(98/PC).

Run the installation

(1) Complete the installation by following the instructions on the screen.

(2) The Readme file appears when the installation is complete.

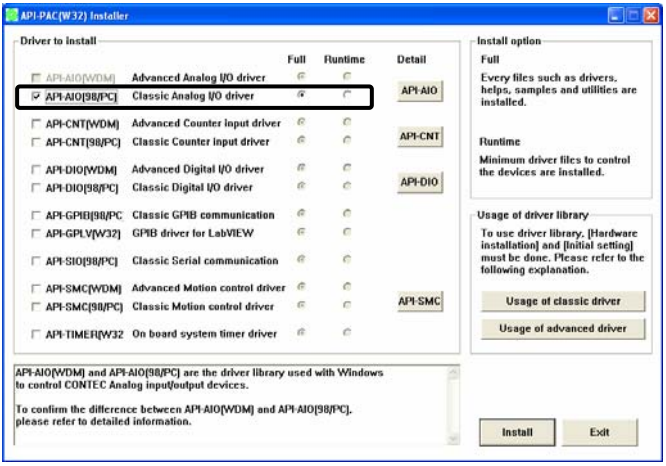
Select API-AIO(98/PC)

Select API-AIO(98/PC)

(1) **The following dialog box appears to select "Driver to install" and "Install option", "Usage of driver library".**

(2) **Select "Classic Analog I/O driver".**

(3) **Click on the [Install] button.**


API-PAC(W32) Installer
Driver to install
Full
Runtime
Detail
API-AIO(WDM) Advanced Analog I/O driver
API-AIO(98/PC) Classic Analog I/O driver
API-AIO
API-CNT(WDM) Advanced Counter Input driver
API-CNT(98/PC) Classic Counter Input driver
API-CNT
API-DIO(WDM) Advanced Digital I/O driver
API-DIO(98/PC) Classic Digital I/O driver
API-DIO
API-GPIB(98/PC Classic GPIB communication
API-GPLV(W32) GPIB driver for LabVIEW
API-SIO(98/PC) Classic Serial communication
API-SMC(WDM) Advanced Motion control driver
API-SMC(98/PC) Classic Motion control driver
API-SMC
API-TIMER(W32 On board system timer driver
API-AIO(WDM) and API-AIO(98/PC) are the driver library used with Windows to control CONTEC Analog input/output devices.
To confirm the difference between API-AIO(WDM) and API-AIO(98/PC), please refer to detailed information.
Install option
Full
Every files such as drivers, helps, samples and utilities are installed.
Runtime
Minimum driver files to control the devices are installed.
Usage of driver library
To use driver library, [Hardware installation] and [Initial setting] must be done. Please refer to the following explanation.
Usage of classic driver
Usage of advanced driver
Install
Exit

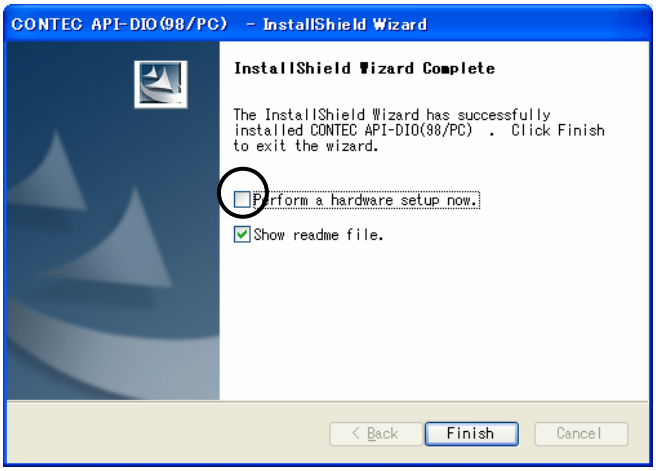
* Clicking on the [API-AIO] button under the "Detail" displays detailed information on API-AIO(WDM), API-AIO(98/PC).

Executing the Installation

(1) **Follow the on-screen instructions to proceed to install.**

(2) When the required files have been copied, the “Perform a hardware setup now” and “Show readme file” check boxes are displayed.
When you are installing the software or hardware for the first time:
1) Uncheck “Perform a hardware setup now”.
2) Click on the [Finish] button.
Go to Step 2 to set and plug the hardware.

* When the hardware has already been installed:
Check “Perform a hardware setup now”, then go to Step 4 “Initializing the Software”.


CONTEC API-DIO(98/PC) - InstallShield Wizard
InstallShield Wizard Complete
The InstallShield Wizard has successfully installed CONTEC API-DIO(98/PC) . Click Finish to exit the wizard.
Perform a hardware setup now.
Show readme file.
< Back
Finish
Cancel

You have now finished installing the software.

Step 2 Setting the Hardware

This section describes how to set the board and plug it on your PC.

The board has some switches and jumper to be preset.
Check the on-board switches and jumpers before plugging the board into an expansion slot.

The board can be set up even with the factory defaults untouched. You can change board settings later.

Parts of the Board and Factory Defaults

Figure 2.1. - Figure 2.4. show the names of major parts on the board.

Note that the switch and jumper setting shown below is the factory default.

AIO-121601E3-PE

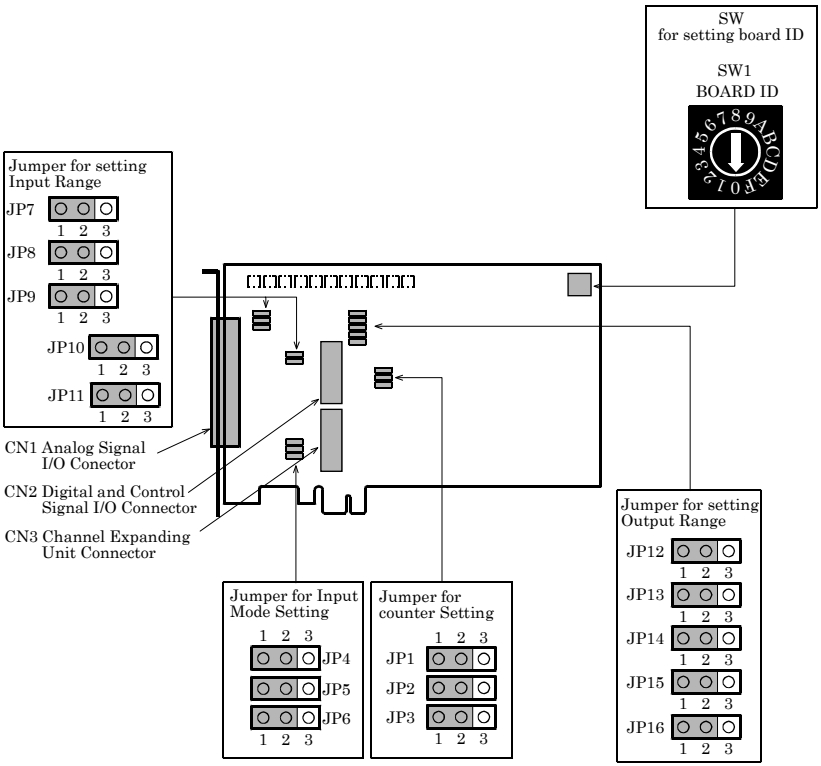


Figure 2.1. Part Names < AIO-121601E3-PE >

AIO-161601E3-PE

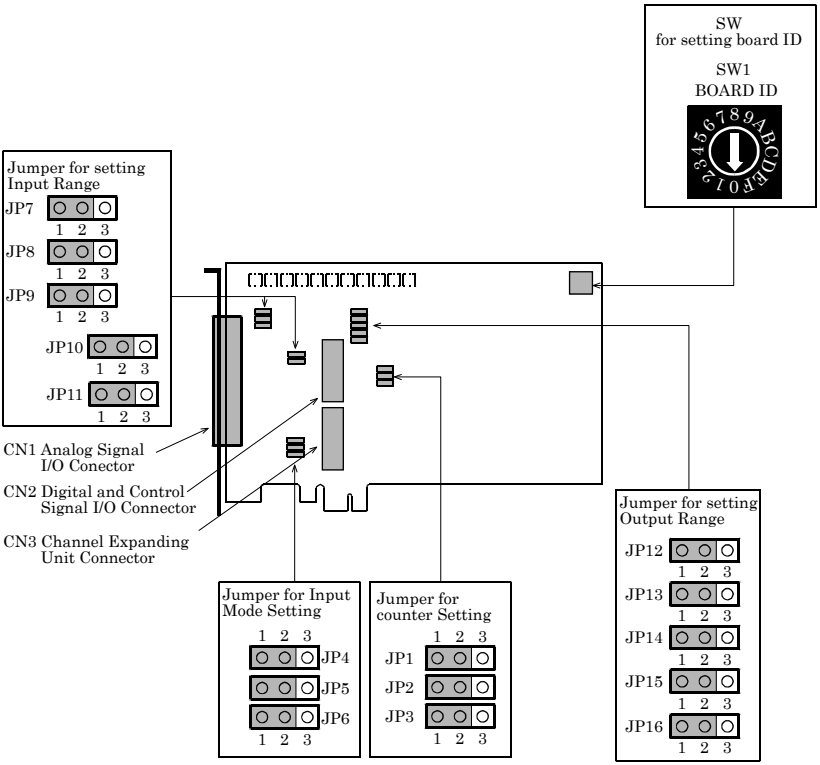


Figure 2.2. Part Names < AIO-161601E3-PE >

AIO-121601UE3-PE

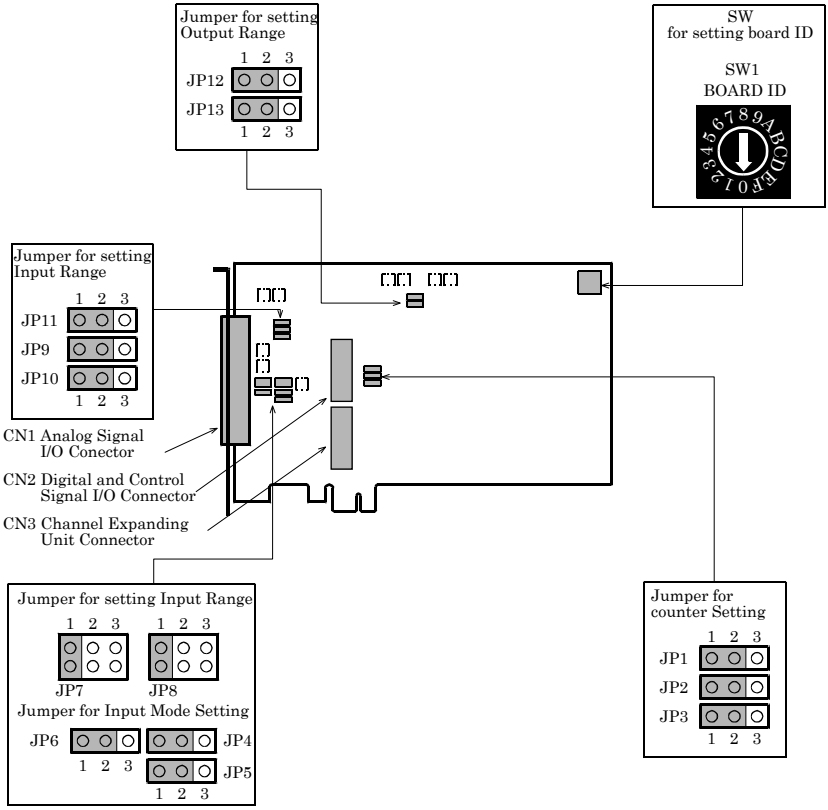


Figure 2.3. Part Names < AIO-121601UE3-PE >

AIO-161601UE3-PE

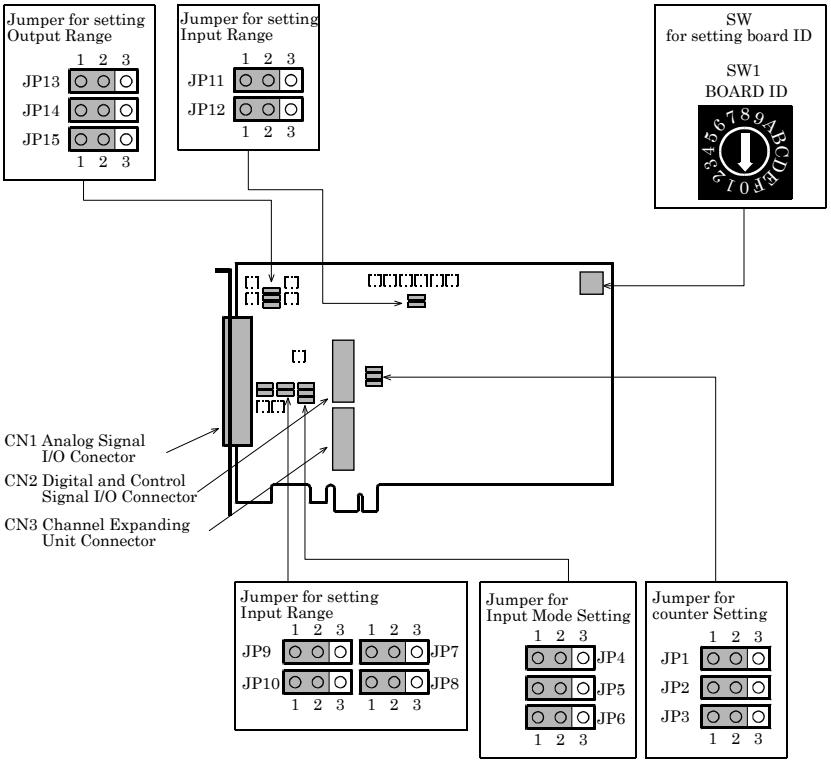


Figure 2.4. Part Names < AIO-161601UE3-PE >

Setting the Board ID

If you install two or more boards on one personal computer, assign a different ID value to each of the boards to distinguish them.

The board IDs can be set from 0 - Fh to identify up to sixteen boards.

If only one board is used, the original factory setting (Board ID = 0) should be used.

Setting Procedure

To set the board ID, use the rotary switch on the board. Turn the SW1 knob to set the board ID as shown below.

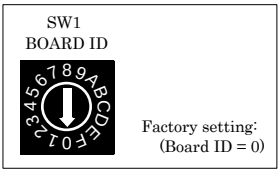


Figure 2.5. Board ID Settings (SW1)

Setting the Analog Input

The analog input is set by specifying the input mode and input range.
For the input mode setting function, see Chapter 4 “Functions”.

Setting the Input Mode

The input mode is the method of connecting analog input signals. The single-ended and differential input modes are available.
The jumper settings for these modes are common to the AIO-121601UE3-PE, AIO-161601UE3-PE, AIO-121601E3-PE and AIO-161601E3-PE.

Use JP4 - JP6 to set the desired input mode.

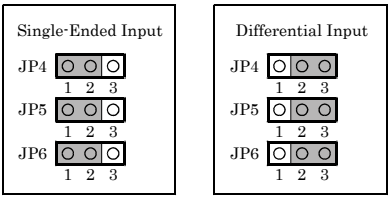


Figure 2.6. Setting the Input Mode

⚠ CAUTION

Do not set the jumpers to any strapping pattern other than those specified above. Doing so can result in a fault in the board.

Setting the Input Range

The input range indicates the range of voltages of analog input signals.
The board converts the voltages in the preset input range into digital signals according to the resolution.
The input range is common to all channels; it is not possible to set a different input range for each channel.
Figures 2.7 - 2.10 illustrates the jumper settings on each board.

For AIO-121601E3-PE, the input range is set both by the jumpers (selecting bipolar or unipolar) and by software (setting the input range).
The models other than AIO-121601E3-PE are set by the jumpers.

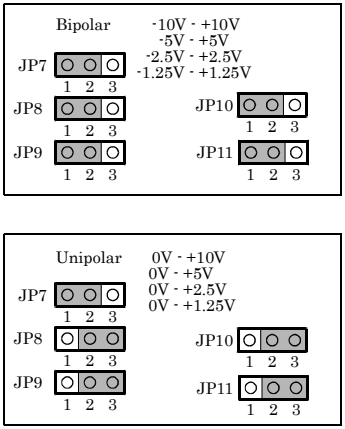


Figure 2.7. Setting the Input Range < AIO-121601E3-PE >

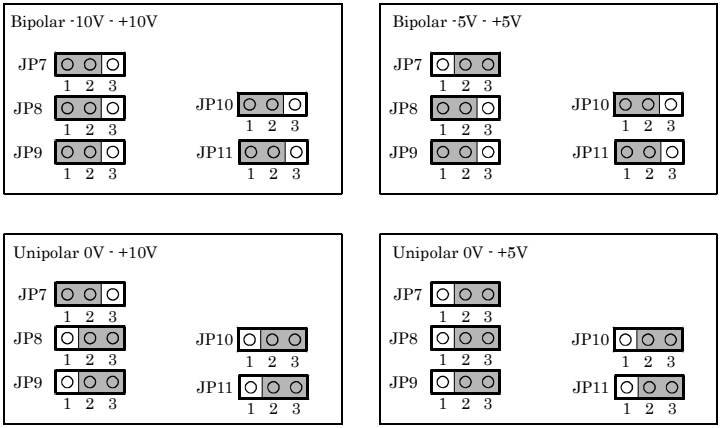


Figure 2.8. Setting the Input Range < AIO-161601E3-PE >

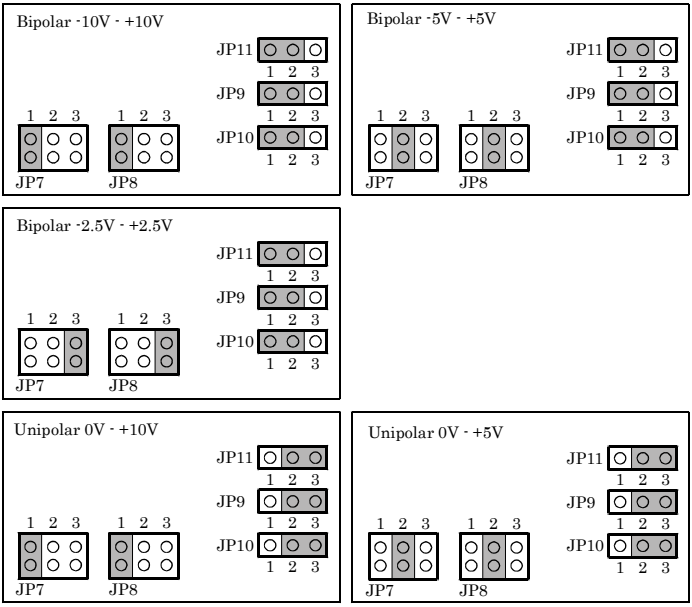


Figure 2.9. Setting the Input Range < AIO-121601UE3-PE >

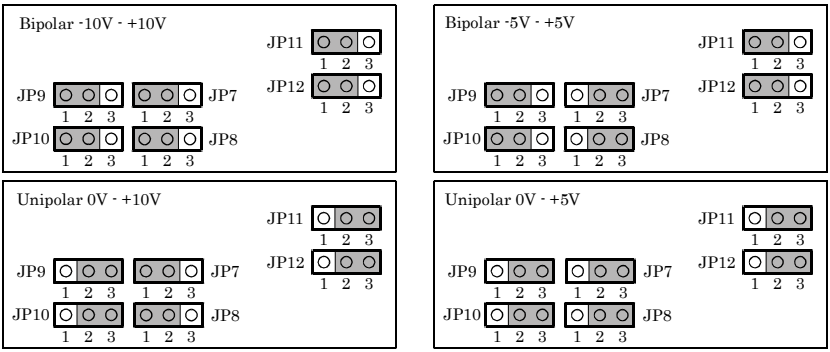


Figure 2.10. Setting the Input Range <AIO-161601UE3-PE>

⚠ CAUTION

Do not set the jumpers to any strapping pattern other than those specified above. Doing so can result in a fault in the board.

Setting the Analog Output

The analog output is set by specifying the output range.
The output range indicates the range of voltages of analog output signals.
The board converts digital signals into voltages in the preset output range according to the resolution.
Figures 2.11 - 2.14 illustrates the jumper settings on each board.

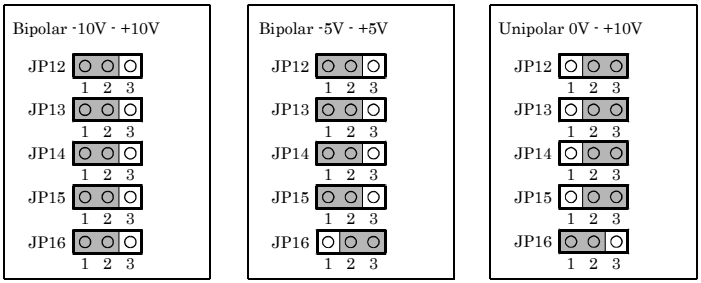


Figure 2.11. Setting the Analog Output < AIO-121601E3-PE >

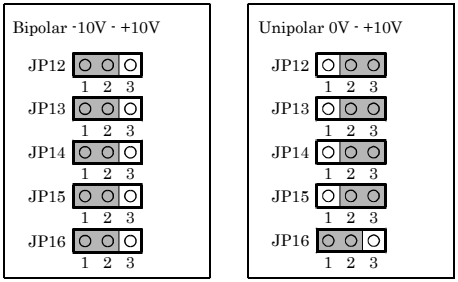


Figure 2.12. Setting the Analog Output < AIO-161601E3-PE >

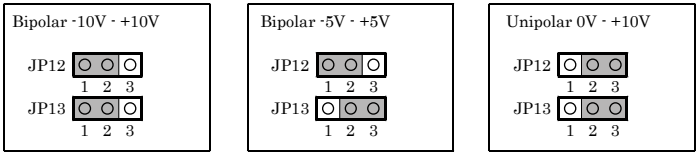


Figure 2.13. Setting the Analog Output < AIO-121601UE3-PE >

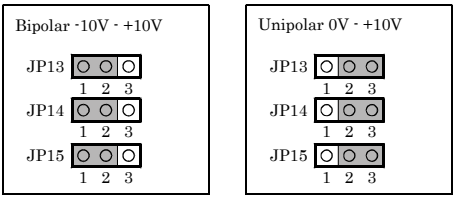


Figure 2.14. Setting the Analog Output < AIO-161601UE3-PE >

⚠ CAUTION

Do not set the jumpers to any strapping pattern other than those specified above. Doing so can result in a fault in the board.

Setting the Counter Control and Digital I/O Signals

The board has a component equivalent to the i8254, which contains three 16-bit counters. You can set the connections of counter control signals (counter output signal, gate signal, and clock input signal). Some of the counter control signals and digital I/O signals are shared, which are set altogether.
For the digital input, digital output, and counter functions, see Chapter 4 “Functions”.

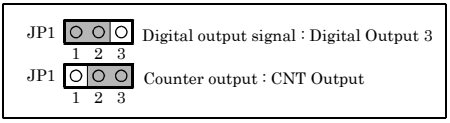


Figure 2.15. Settings the Signals to Be Connected to CN2[10pin] Digital Output3 and CNT Output

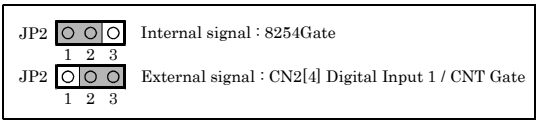


Figure 2.16. Settings the Signals to Be Connected to gate of COUNTER1/COUNTER2

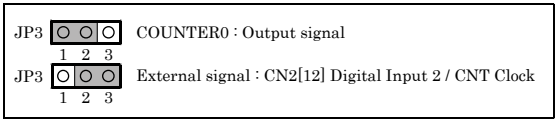


Figure 2.17. Settings the Signals to Be Connected to Clock of

⚠ CAUTION

- External signals for counter control must be TTL-level signals.
- CNTCLK and CNTGATE serve also as DI2 and DI1, respectively.
- Only one of the CNTOUT and DO3, which is selected by JP1, is output from CN2.
- In API-AIO(WDM), the counter function is not supported. Please match the jumper to the setting when you ship it.

Plugging the Board

(1) Before plugging the board, shut down the system, unplug the power code of your PC.

(2) Remove the cover from the PC so that the board can be mounted.

(3) Plug the board into an expansion slot.

(4) Attach the board bracket to the PC with a screw.

(5) Put the cover back into place.

⚠ CAUTION

- Do not touch the board's metal plated terminals (edge connector) with your hands.
  Otherwise, the board may malfunction, overheat, or cause a failure.
  If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
- Do not install or remove the board to or from the slot while the computer's power is turned on.
  Otherwise, the board may malfunction, overheat, or cause a failure.
  Doing so could cause trouble. Be sure that the personal computer or the I/O expansion unit power is turned off.
- Make sure that your PC or expansion unit can supply ample power to all the boards installed.
  Insufficiently energized boards could malfunction, overheat, or cause a failure.

Step 3 Installing the Hardware

For using an expansion board under Windows, you have to let the OS detect the I/O addresses and IRQ to be used by the board. The process is referred to as installing the hardware.

In the case of using two or more boards, make sure you install one by one with the Add New Hardware Wizard.

Turning on the PC

Turn on the power to your PC.

⚠ CAUTION

- The board cannot be properly installed unless the resources (I/O addresses and interrupt level) for the board can be allocated. Before attempting to install the board, first determine what PC resources are free to use.
- The resources used by each board do not depend on the location of the PCI bus slot or the board itself. If you remove two or more boards that have already been installed and then remount one of them on the computer, it is unknown that which one of the sets of resources previously assigned to the two boards is assigned to the remounted board. In this case, you must check the resource settings.

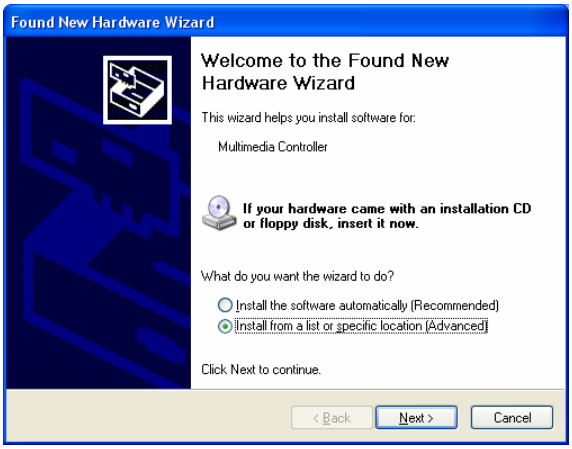
When Using the API-AIO(WDM)

(1) The “Found New Hardware Wizard” will be started.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

Select “No, not this time” and then click the “Next” button.

(2) When “Multimedia Controller” is displayed, select “Install from a list or specific location[Advanced]” and then specify that folder on the CD-ROM which contains the setup information (INF) file to register the board.

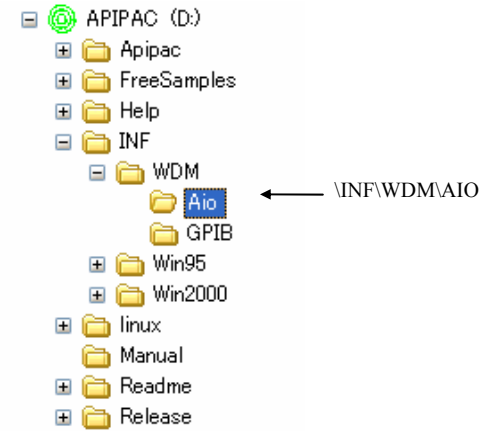

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
Multimedia Controller
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

When the model name of hardware is displayed, select “Install the software automatically [Recommended]” and then click on the “Next” button.

Source folder

The setup information (INF) file is contained in the following folder on the bundled CD-ROM.

\INF\WDM\AIO



You have now finished installing the hardware.

When Using the API-AIO(98/PC)

(1) The “Found New Hardware Wizard” will be started.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

Select “No, not this time” and then click the “Next” button.

(2) Select “Install from a list or specific location[Advanced]” and then click the “Next” button.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
Multimedia Controller
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

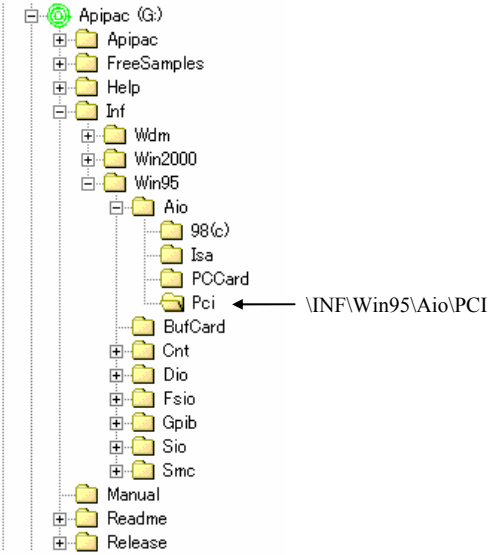
(3) Specify that folder on the CD-ROM which contains the setup information (INF) file to register the board.

Source folder

The setup information (INF) file is contained in the following folder on the bundled CD-ROM.

Windows Vista, XP, Server 2003, 2000	\INF\Win2000\Aio\PCI
Windows Me, 98, 95	\INF\Win95\Aio\PCI

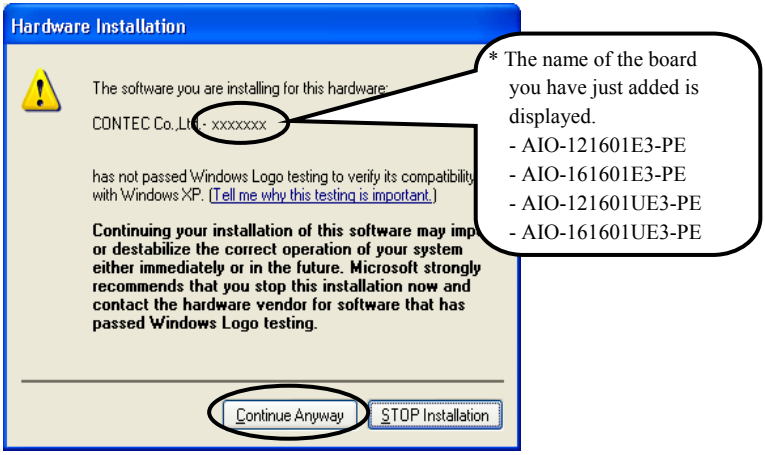
Example of specifying the folder for use under Windows XP



⚠ CAUTION

In Windows XP, the Hardware Wizard displays the following alert dialog box when you have located the INF file. This dialog box appears, only indicating that the relevant driver has not passed Windows Logo testing, and it can be ignored without developing any problem with the operation of the board.

In this case, click on the [Continue Anyway] button.


Hardware Installation
The software you are installing for this hardware:
CONTEC Co.,Ltd - xxxxxxx
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may imp
or destabilize the correct operation of your system
either immediately or in the future. Microsoft strongly
recommends that you stop this installation now and
contact the hardware vendor for software that has
passed Windows Logo testing.
Continue Anyway
STOP Installation
* The name of the board you have just added is displayed.
- AIO-121601E3-PE
- AIO-161601E3-PE
- AIO-121601UE3-PE
- AIO-161601UE3-PE

You have now finished installing the hardware.

Step 4 Initializing the Software

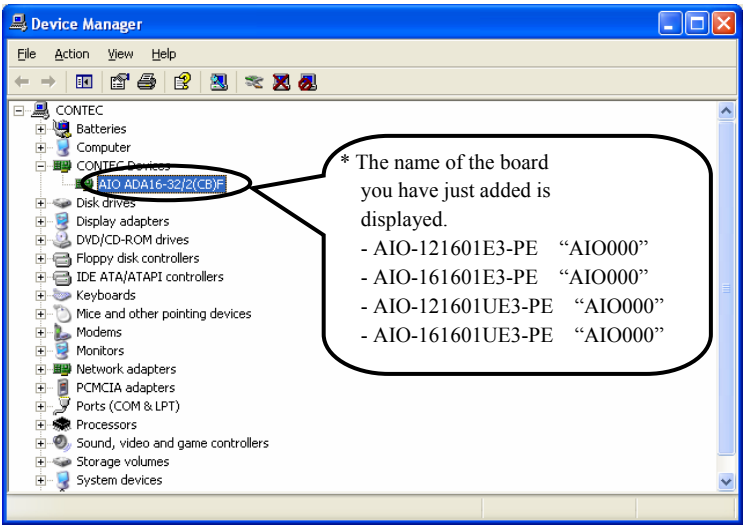
The driver library requires initial settings to determine the execution environment. This is called driver library initialization.

When Using the API-AIO(WDM)

API-AIO(WDM) is initialized automatically during hardware installation. Therefore, if you want to use it with its initial settings, you can skip the setting procedure described in Step 4. To change the device name, follow the setting procedure shown below.

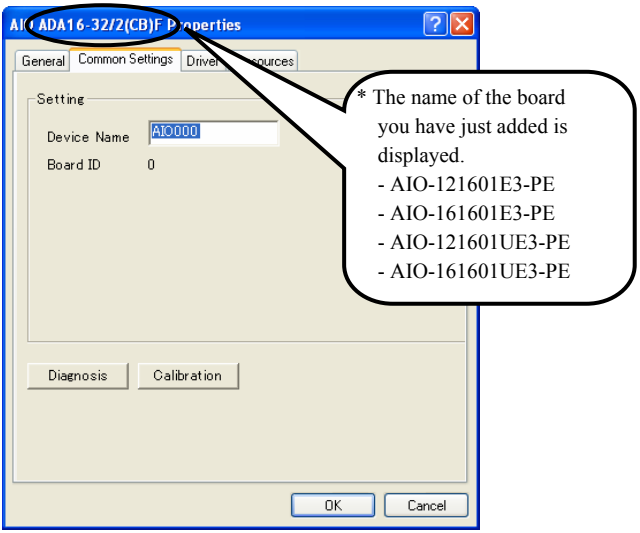
Setting the device name

(1) Run Device Manager. From [My Computer] - [Control Panel], select [System] and then select the [Device Manager] tab.
(You can also open Device Manager by right clicking on My Computer and selecting Properties.)



(2) The installed hardware appears under the CONTEC Devices node. Open the CONTEC Devices node and select the device you want to setup (the device name should appear highlighted). Click [Properties].

(3) The property page for the device opens.
Enter the device name in the common settings tab page and then click [OK].
The device name you set here is used later when programming.



* The initial device name that appears is a default value. You can use this default name if you wish.

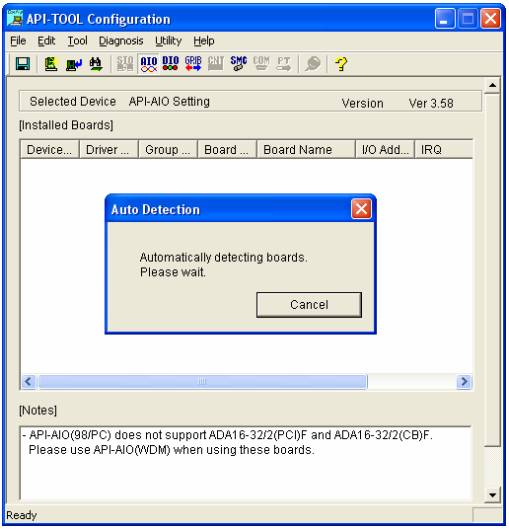
* Make sure that you do not use the same name for more than one device.

You have now finished installing the initial setting of Software.

When Using the API-AIO(98/PC)

Invoking API-TOOL Configuration

(1) Open the Start Menu, then select “Programs” – “CONTEC API-PAC(W32)” – “API-TOOL Configuration”.



(2) API-TOOL Configuration detects boards automatically.
The detected boards are listed.

Updating the Settings

(1) Select “Save setting to registry…” from the “File” menu.

You have now finished installing the initial setting of Software.

Step 5 Checking Operations with the Diagnosis Program

Use the diagnosis program to check that the board and driver software work normally, thereby you can confirm that they have been set up correctly.

What is the Diagnosis Program?

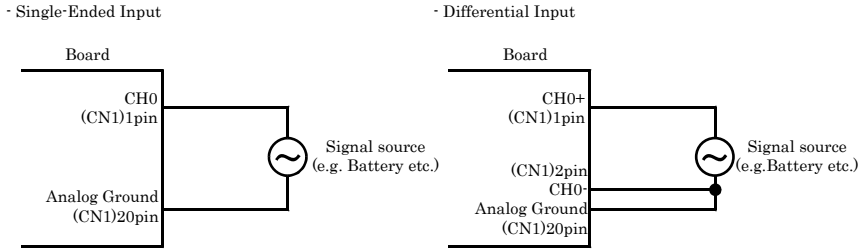
The diagnosis program diagnoses the states of the board and driver software.
It can also be used as a simple checker when an external device is actually connected.
Using the "Diagnosis Report" feature reports the driver settings, the presence or absence of the board, I/O status, and interrupt status.

Check Method

To check analog I/O data, connect the signal.
The diagrams below show examples of using channel 0 on the AIO-121601UE3-PE. For details on the connections, see Chapter 3 "External Connection". Check the board with the factor defaults untouched.

Wiring Diagram

< Analog input >



⚠ CAUTION

- To check the analog input in differential input mode, set the jumpers to change the input mode setting in advance. For details, see "Setting the Analog Input" in this chapter.
- Input data remains indeterminate when no input pin is connected. The input pin for the channel not connected to the signal source must be connected to the analog ground. For details, see "Chapter 3 External Connection".

<Analog output>

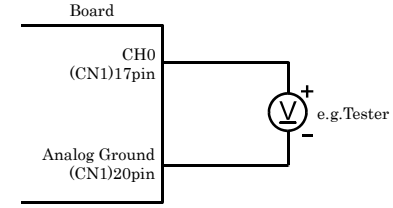
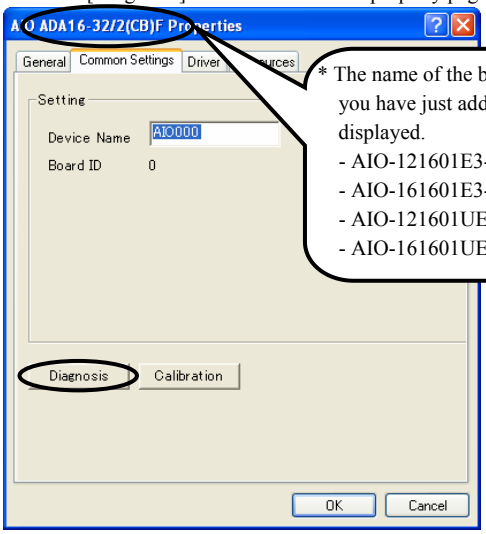


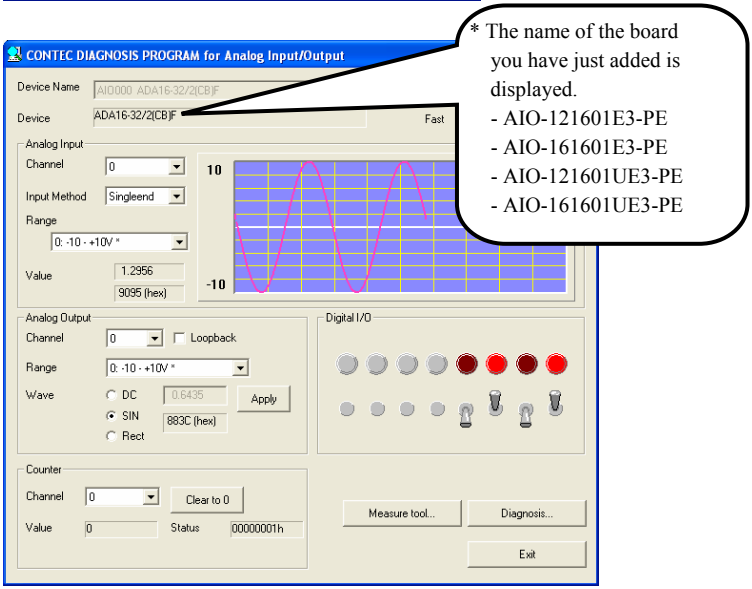
Figure 2.18. Wiring Diagram

Using the Diagnosis Program for Use of API-AIO(WDM)

Starting the Diagnosis Program

Click the [Diagnosis] button on the device property page to start the diagnosis program.





Analog input

You can select the desired input channel and input range from the lists.
Input data is plotted on a graph.

Analog output

You can select the desired output channel and output range from the lists.

You can set the output data to DC (constant voltage), sine wave, or square wave.

Digital input / output

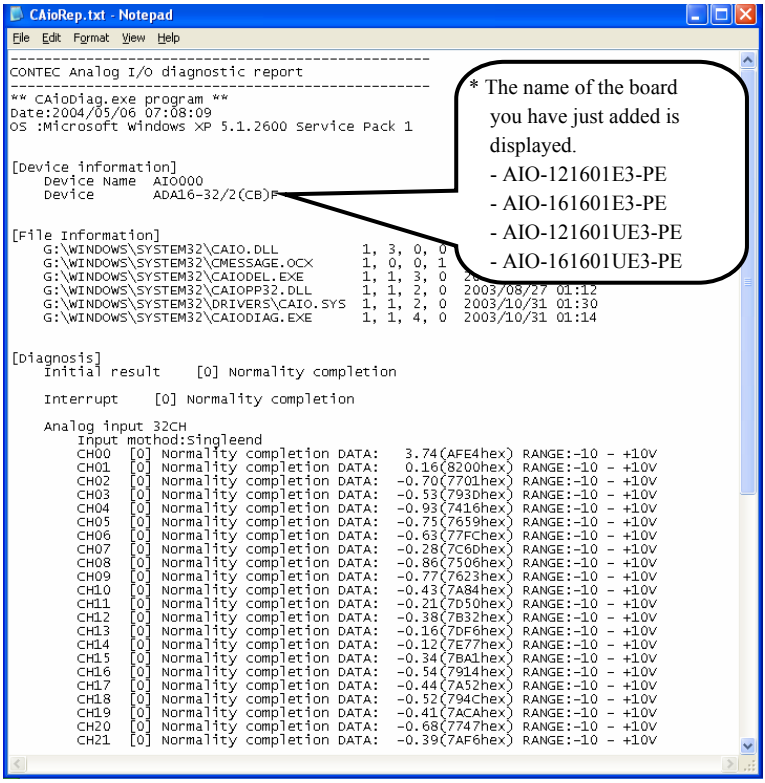
The upper row of circular lamps indicates the digital input states. Red indicates the bit is ON and brown indicates OFF.

Clicking the lower row of switches turns the digital output bits ON or OFF.

Diagnosis Report

(1) The diagnosis report saves detailed data, including the device settings and settings for each channel, to a text file and displays the file for you to view.

Clicking [Diagnosis Report] prompts you to specify where to save the report text file.


CAioRep.txt - Notepad
File Edit Format View Help
CONTEC Analog I/O diagnostic report
** CAIodiag.exe program **
Date:2004/05/06 07:08:09
OS :Microsoft Windows XP 5.1.2600 Service Pack 1
[Device information]
Device Name AIO000
Device ADA16-32/2(CB)F
[File Information]
G:\WINDOWS\SYSTEM32\CAIO.DLL 1, 3, 0, 0
G:\WINDOWS\SYSTEM32\CMESSAGE.OCX 1, 0, 0, 1
G:\WINDOWS\SYSTEM32\CAIODEL.EXE 1, 1, 3, 0
G:\WINDOWS\SYSTEM32\CAIOPP32.DLL 1, 1, 2, 0 2003/08/27 01:12
G:\WINDOWS\SYSTEM32\DRIVERS\CAIO.SYS 1, 1, 2, 0 2003/10/31 01:30
G:\WINDOWS\SYSTEM32\CAIODIAG.EXE 1, 1, 4, 0 2003/10/31 01:14
[Diagnosis]
Initial result [0] Normality completion
Interrupt [0] Normality completion
Analog input 32CH
Input mothod:Singleend
CH00 [0] Normality completion DATA: 3.74(AFE4hex) RANGE:-10 - +10V
CH01 [0] Normality completion DATA: 0.16(8200hex) RANGE:-10 - +10V
CH02 [0] Normality completion DATA: -0.70(7701hex) RANGE:-10 - +10V
CH03 [0] Normality completion DATA: -0.53(793Dhex) RANGE:-10 - +10V
CH04 [0] Normality completion DATA: -0.93(7416hex) RANGE:-10 - +10V
CH05 [0] Normality completion DATA: -0.75(7659hex) RANGE:-10 - +10V
CH06 [0] Normality completion DATA: -0.63(77FChex) RANGE:-10 - +10V
CH07 [0] Normality completion DATA: -0.28(7C6Dhex) RANGE:-10 - +10V
CH08 [0] Normality completion DATA: -0.86(7506hex) RANGE:-10 - +10V
CH09 [0] Normality completion DATA: -0.77(7623hex) RANGE:-10 - +10V
CH10 [0] Normality completion DATA: -0.43(7A84hex) RANGE:-10 - +10V
CH11 [0] Normality completion DATA: -0.21(7D50hex) RANGE:-10 - +10V
CH12 [0] Normality completion DATA: -0.38(7B32hex) RANGE:-10 - +10V
CH13 [0] Normality completion DATA: -0.16(7DF6hex) RANGE:-10 - +10V
CH14 [0] Normality completion DATA: -0.12(7E77hex) RANGE:-10 - +10V
CH15 [0] Normality completion DATA: -0.34(7BA1hex) RANGE:-10 - +10V
CH16 [0] Normality completion DATA: -0.54(7914hex) RANGE:-10 - +10V
CH17 [0] Normality completion DATA: -0.44(7A52hex) RANGE:-10 - +10V
CH18 [0] Normality completion DATA: -0.52(794Chex) RANGE:-10 - +10V
CH19 [0] Normality completion DATA: -0.41(7ACAhex) RANGE:-10 - +10V
CH20 [0] Normality completion DATA: -0.68(7747hex) RANGE:-10 - +10V
CH21 [0] Normality completion DATA: -0.39(7AF6hex) RANGE:-10 - +10V
* The name of the board you have just added is displayed.
- AIO-121601E3-PE
- AIO-161601E3-PE
- AIO-121601UE3-PE
- AIO-161601UE3-PE

(2) The diagnosis report contains the following data.

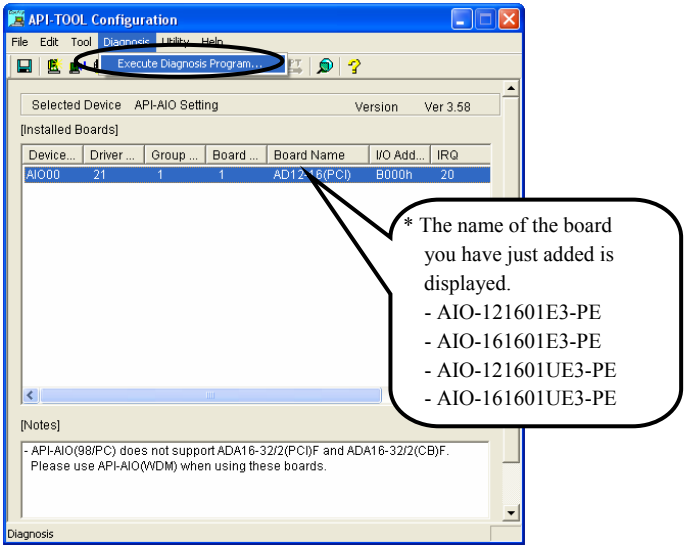
- Version of OS
- Device Information
- File Information

Initialization, interrupts, current input or output state for each channel

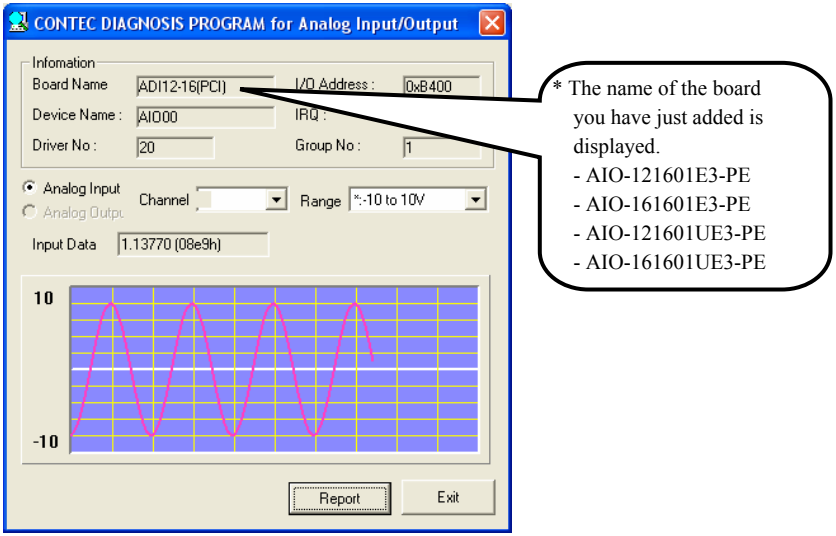
Using the Diagnosis Program for Use of API-AIO(98/PC)

Starting the Diagnosis Program

After selecting the board in [API-TOOL Configuration], run the diagnosis program. Follow the on-screen instructions.


API-TOOL Configuration
File Edit Tool Diagnosis Utility Help
Execute Diagnosis Program...
Selected Device API-AIO Setting
Version Ver 3.58
[Installed Boards]
Device... Driver ... Group ... Board ... Board Name I/O Add... IRQ
AIO00 21 1 1 AD12-16(PCI) B000h 20
[Notes]
- API-AIO(98/PC) does not support ADA16-32/2(PCI)F and ADA16-32/2(CB)F.
Please use API-AIO(WDM) when using these boards.
Diagnosis
* The name of the board you have just added is displayed.
- AIO-121601E3-PE
- AIO-161601E3-PE
- AIO-121601UE3-PE
- AIO-161601UE3-PE

Checking the Analog Input/Output



Analog input

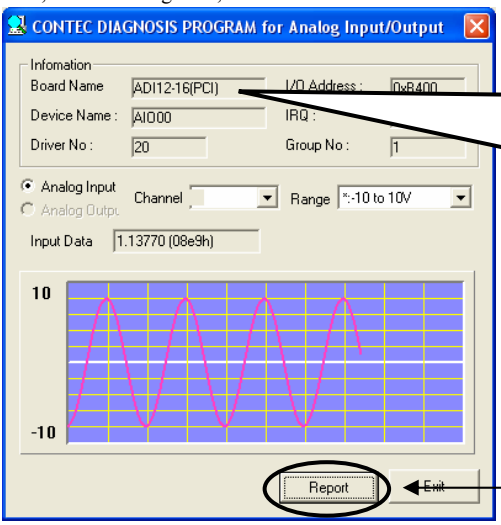
You can select the desired input channel and input range from the lists.
Input data is plotted on a graph.

Analog output

You can select the desired output channel and output range from the lists.

Diagnosis Report

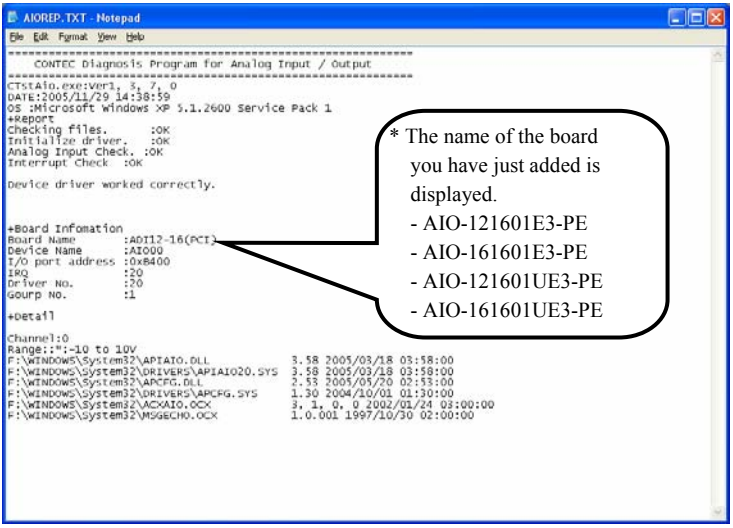
(1) Clicking on the [Report] button displays detailed data such as a board, channel settings and the diagnosis results while saving them in text format.
The results are saved and displayed as a text file (AioRep.txt) in the install folder (CONTEC/CONTECW95).
The Diagnosis Program performs “board presence/absence check”, “interrupt test”, “driver file test”, “board setting test”, and so on.



* The name of the board you have just added is displayed.
- AIO-121601E3-PE
- AIO-161601E3-PE
- AIO-121601UE3-PE
- AIO-161601UE3-PE

Click on [Report].

(2) A diagnosis report is displayed as shown below.



* The name of the board you have just added is displayed.
- AIO-121601E3-PE
- AIO-161601E3-PE
- AIO-121601UE3-PE
- AIO-161601UE3-PE

Setup Troubleshooting

Symptoms and Actions

Data input or output does not operate correctly

- Run the diagnosis program to check that the device is registered and whether any initialization errors have occurred.
- Is there a problem with the device settings, wiring, or similar? Check the I/O range setting. Also, the input data will be undefined if the wiring terminals are not connected. Ensure that the channels you are using are correctly connected. Connect unused channels to analog ground.
- For voltage input, check by connecting a battery or similar if you do not have any other suitable signal source. Also check that connecting to analog ground reads correctly as 0V.

The board works with the Diagnosis Program but not with an application.

The Diagnosis Program is coded with API-TOOL functions. As long as the board operates with the Diagnosis Program, it is to operate with other applications as well. In such cases, review your program while paying attention to the following points:

- Check the return values of the API functions.
- Refer to the source code for the sample programs.

The OS won’t normally get started or detect the device.

Refer to the "Troubleshooting" section of API-AIO(WDM) HELP.

If your problem cannot be resolved

Contact your retailer.

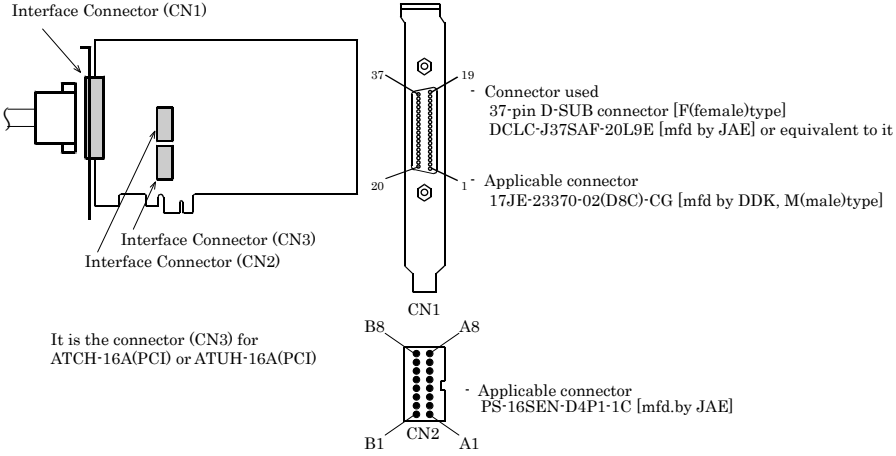
3. External Connection

This chapter describes the interface connectors on the board and the external I/O circuits.
Check the information available here when connecting an external device.

How to connect the connectors

Connector shape

To connect an external device to this board, plug the cable from the device into the interface connector (CN1, CN2) shown below.
The board has two interface connectors: the analog I/O connector (CN1: 37-pin female D-SUB connector) and the control signal connector (CN2: 16-pin pin-header) for digital input/output and counter control.



* Please refer to chapter 1 for more information on the supported cable and accessories.

Figure 3.1. Interface Connector Shape

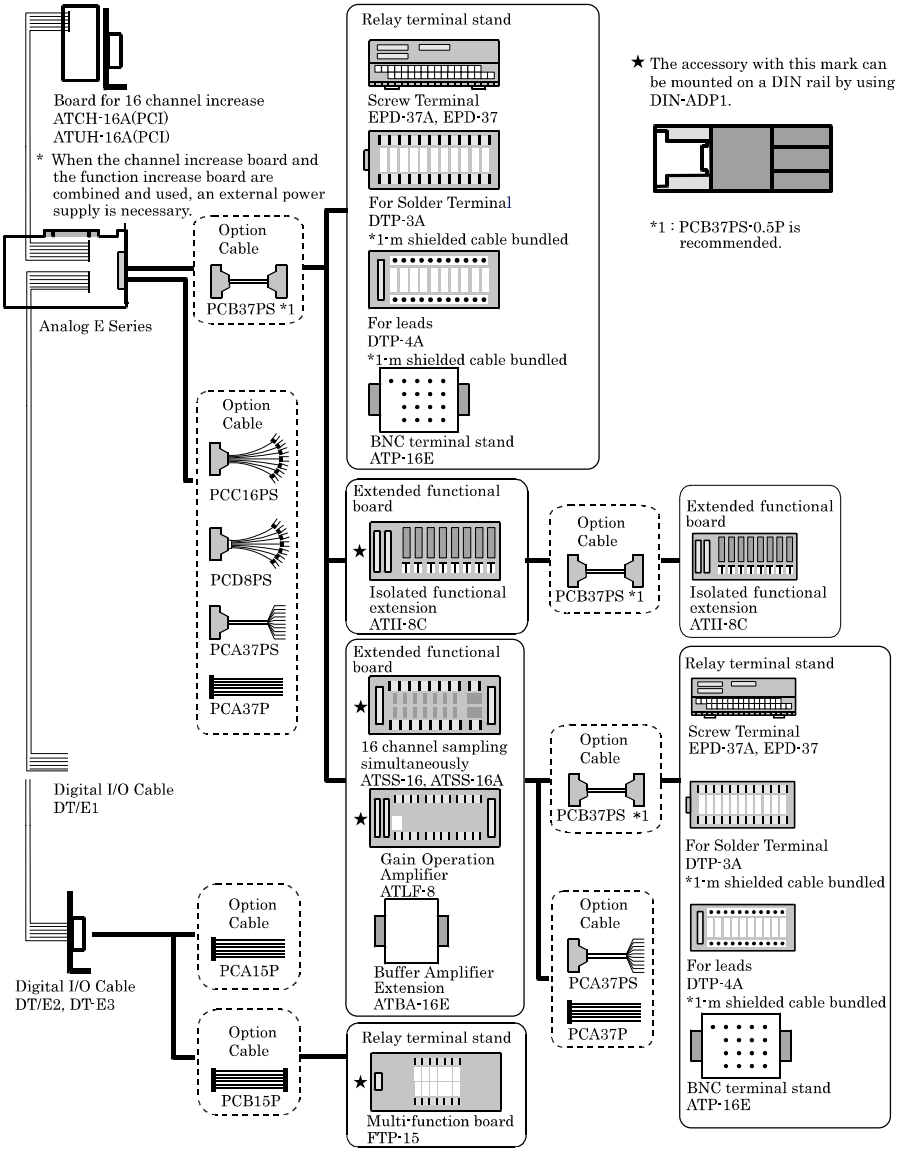
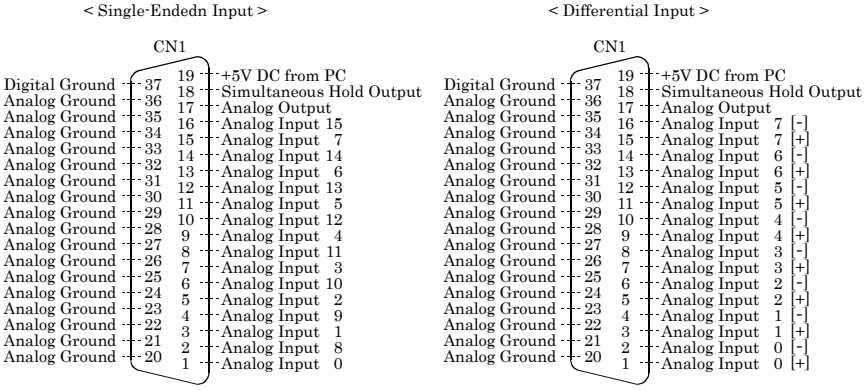


Figure 3.2. Examples of Connecting Options

Connector Pin Assignment

Pin Assignment of CN1



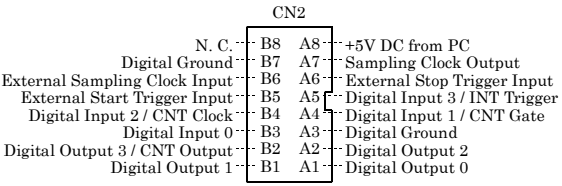
Analog Input 0 - Analog Input 15	Analog input signals in single-ended input mode. The numbers correspond to channel numbers.
Analog Input 0[+] - Analog Input 7[+]	Analog input signals in differential input mode. The numbers correspond to channel numbers.
Analog Input 0[-] - Analog Input 7[-]	Analog input signals in differential input mode. The numbers correspond to channel numbers.
Analog Output	Analog output signal
Analog Ground	Analog ground common to analog I/O signals.
Simultaneous Hold Output	Control signal for simultaneous sampling unit ATSS-16 available as an option.
+5V DC from PC	Outputs +5V. The total current-carrying capacity that can be supplied with 5V output of CN2 is 0.9A.
Digital Ground	Digital ground common to "Simultaneous Hold Output" and "+5V DC from PC".

Figure 3.3. Pin Assignment of CN1

⚠ CAUTION

Do not connect any of the outputs and power outputs to the analog or digital ground.
Neither connect outputs to each other. Doing either can result in a fault.

Pin Assignment of CN2



Digital Input 0	Digital input signal.
Digital Input 1 /CNT Gate	Digital input signal. Also serving as the counter gate control input signal.
Digital Input 2 /CNT Clock	Digital input signal. Also serving as the clock input signal
Digital Input 3 /INT Trigger	Digital input signal. Also serving as the interrupt input signal.
Digital Out 0 to Digital Out 2	Digital output signal.
Digital Out 3 to CNT Output	Digital output signal. Capable of being jumper-switched to serve as the counter output signal.
External Start Trigger Input	External trigger input signal for sampling start conditions
External Stop Trigger Input	External trigger input signal for sampling stop conditions
External Sampling Clock Input	External sampling clock input signal
Sampling Clock Output	Sampling clock output signal
+5V DC from PC	Outputs +5V. The total current-carrying capacity that can be supplied with 5V output of CN1 is 0.9A.
Digital Ground	Digital ground common to the signals and "+5V DC from PC".
N.C.	No connection to this pin.

Figure 3.4. Pin Assignment of CN2

⚠ CAUTION

Do not connect any of the outputs and power outputs to the analog or digital ground.
Neither connect outputs to each other. Doing either can result in a fault.

Analog Input Signal Connection

There are two analog input mode: the Single-ended input and the Differential input. Here we give some examples of analog input connections by using flat cable or shield cable.

Single-ended Input

The following figure shows an example of flat cable connection. Each signal source is connected to one analog input channel and the signal common to analog ground pin of CN1.

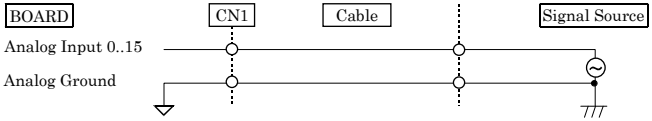


Figure 3.5. Single-ended Input Connection (Flat Cable)

The following figure shows an example of shield cable connection. When the distance between the signal source and the board is long or you want to increase the noise tolerance, a shield cable is suggested. Connect the signal by the core wire and common signal by the shield braids.

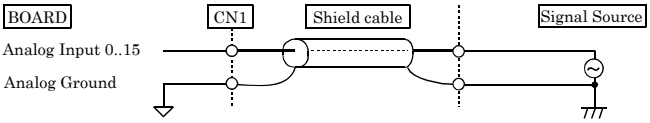


Figure 3.6. Single-ended Input Connection (Shield Cable)

⚠ CAUTION

- If the signal source contains over 100kHz [AIO-121601E3-PE / AIO-161601E3-PE] or 1MHz [AIO-121601UE3-PE / AIO-161601UE3-PE] signals, the signal may effect the cross-talk noise between channels.
- If the board and the signal source receive noise or the distance between the board and the signal source is too long, data may not be input properly.
- An input analog signal should not exceed the maximum input voltage (relate to the board analog ground). If it exceeds the maximum voltage, the board may be damaged.
- Connect all the unused analog input channels to analog ground.

Differential Input

The following figure shows an example of flat cable connection. Each signal source is connected to a [+] pin of analog input channel and the signal common of this source to the [-] pin of this input channel of CN1. In addition, the signal common must be connected to the pin of the analog ground of CN1 by a third wire.

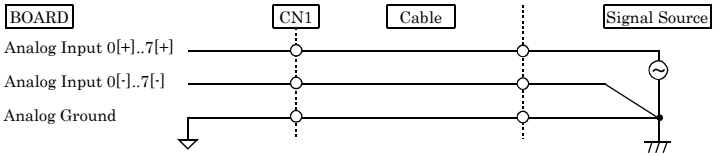


Figure 3.7. Differential Input Connection (Flat Cable)

The following figure shows an example of 2-wire shielded cable connection. When the distance between the signal source and the board is long or you want to increase the noise tolerance, a shield cable connection is preferred. Each signal source is connected to a [+] pin of analog input channel and the signal common of this source to the [-] pin of this input channel of CN1. In addition, the signal common must be connected to the pin of the analog ground of CN1 by the shielded braids.

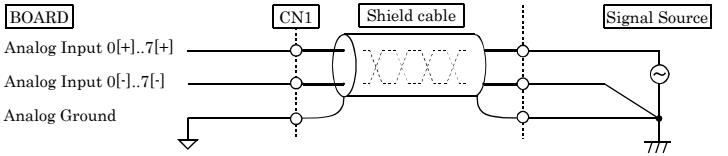


Figure 3.8. Differential Input Connection (Shield Cable)

⚠ CAUTION

- If the signal source contains over 100kHz [AIO-121601E3-PE and AIO-161601E3-PE] or 1MHz [AIO-121601UE3-PE and AIO-161601UE3-PE] signals, the signal may effect the cross-talk noise between channels.
- The input data would be uncertain if the analog ground is not connected.
- If the board and the signal source receive noise or the distance between the board and the signal source is too long, data may not be input properly.
- The input voltage from the [+] input or [-] input should not exceed the maximum input voltage (based on the board analog ground). If it exceeds the maximum voltage, the board may be damaged.
- Because the input data will be uncertain if the [+] pin or the [-] pin of CN1 is not connected, all the unused input pins of CN1 should be connected to the analog ground, AGND.

Analog Output Signal Connection

This section shows how to connect the analog output signal by using a flat cable or a shielded cable.

The following figure shows an example of flat cable connection.

Connect the signal source and ground to the CN1 analog output.

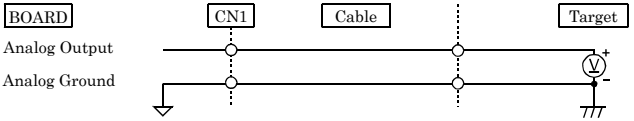


Figure 3.9. Analog Output Connection (Flat Cable)

If the distance between the signal source and the board is long or if you want to increase the noise tolerance, a shield cable connection is strongly recommended.

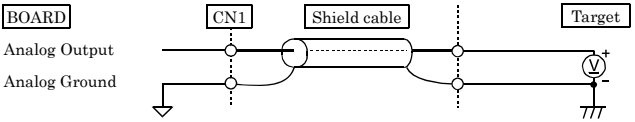


Figure 3.10. Analog Output Connection (Shield Cable)

⚠ CAUTION

- If the board or the connected wire receives noise, or the distance between the board and the target is long, data may not be outputted properly.
- For analog output signal, the current capacity is ±5mA (Max.). Check the specification of the connected device before connecting the board.
- Do not short the analog output signal to analog ground, digital ground, and/or power line. Doing so may damage the board.

Digital I/O signals and Control signals Connection

The digital I/O signals and the control signals are interfaced through the connector CN2. User can use an optional cable DT/E1 or DT/E2 or DT-E3 (with bracket and a 15-pin D type female connector) to connect these signals to your external devices.

All the digital I/O signals and control signals are TTL level signals.

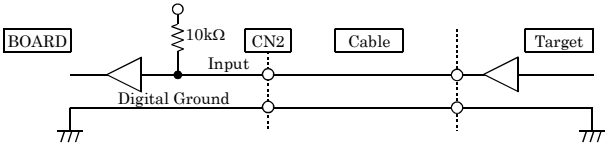


Figure 3.11. Digital Input Connection

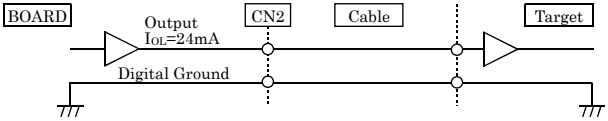


Figure 3.12. Digital Output Connection

⚠ CAUTION

Do not short the output signals to analog ground, digital ground, and/or power line. Doing so may damage the board.

Reference

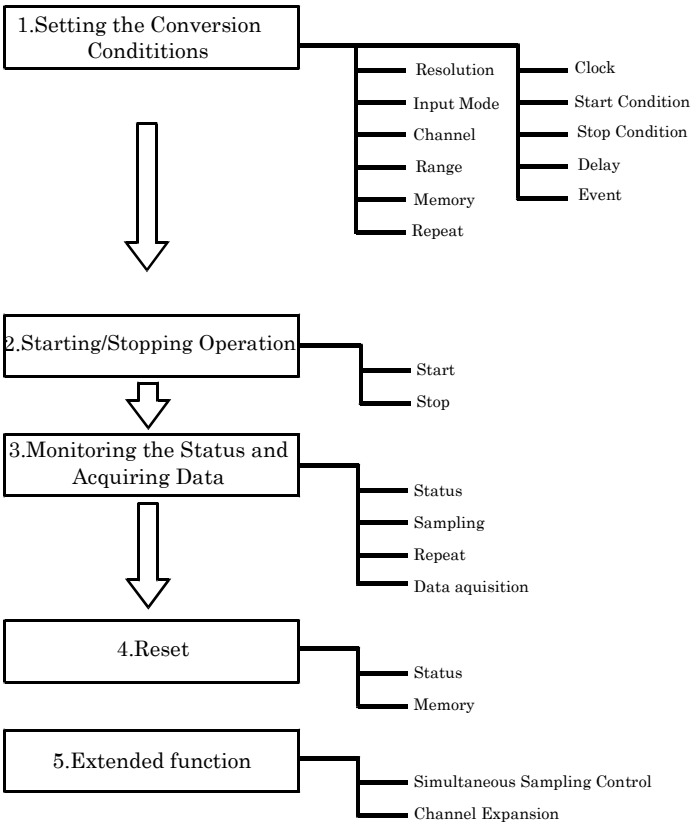
For the operation timings for control signal input, see ”Timing of External Control Signals” in Chapter 6 “Hardware”.

4. Functions

This chapter explains the function that can be achieved by hardware and driver's combinations. The driver indicates the thing of API-AIO(WDM) as long as there is no annotation.

Analog Input Function

The board converts analog signals to digital data according to the resolution and stores it in memory. You can set a variety of conditions for analog input, including the input channel, sampling period, and sampling start/stop conditions.
Analog input processes are classified as follows:

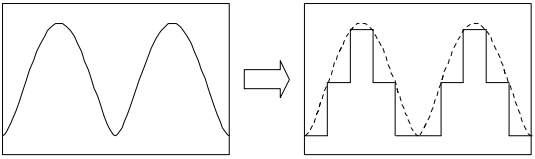


1. Setting the Conversion Conditions

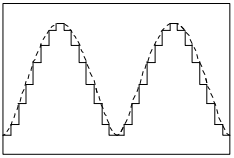
First, set the conditions for executing analog input.

Resolution

”Resolution” signifies the number of bits used by an analog input device to represent analog signals.
The higher the resolution, the more finely the voltage range is segmented, allowing the device to convert analog values to digital equivalents more precisely.
A device with a resolution of 12-bit divides the range width into 4096 segments.
When the device covers the range of 0 - 10 V, the minimum unit of converted voltages is 10÷4096 ≠ 2.44mV.
If the device has a resolution of 16-bit, it is 10÷65536 ≠ 0.153mV instead.



Analog voltage before conversion　　Low-resolution board



High-resolution board

AIO-121601E3-PE and AIO-121601UE3-PE　　: The resolution is 12-bit.
AIO-161601E3-PE and AIO-161601UE3-PE　　: The resolution is 16-bit.

Input Mode

”Input Mode” indicates the method of connecting analog input signals.
The input modes available are single-ended input and differential input.
The single-ended input mode is suitable for the environment in which the potential difference between the signal source and ground and noise components can be ignored.　For the environment in which they cannot be ignored, the differential input mode is suitable.
The number of channels available in differential input mode is half that in single-ended input mode.

This board uses on-board jumpers to set the input mode.
For details, see “Chapter 2 Setup- Setting the Hardware - Setting the Analog Input”.

Channel

“Channel” means each channel number for analog input signals.
For individual channel numbers, see “Using the On-board Connectors” to “Connector Pin Assignment” in Chapter 3 "External Connection".
When selecting a channel, specify its channel No. or the number of channels on which you wish to perform AD conversion (consecutive channels starting from channel 0).

Range

"Range" means the range of voltages at which analog input can be performed.

The input range can be selected by setting the upper and lower input signals.

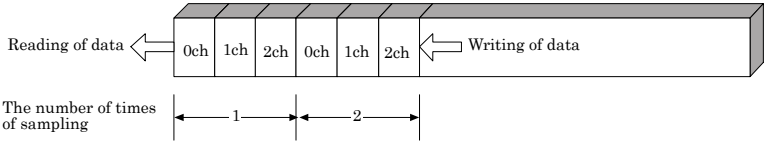
AIO-121601E3-PE : The range is specified by setting both jumpers and software.
AIO-161601E3-PE : The range is specified by setting the jumpers.
AIO-121601UE3-PE : The range is specified by setting the jumpers.
AIO-161601UE3-PE : The range is specified by setting the jumpers.
For details, see "Chapter 2 Setup- Setting the Hardware - Setting the Analog Input".

AIO-121601E3-PE, AIO-161601E3-PE, AIO-121601UE3-PE, AIO-161601UE3-PE
: For the memory, 16M data is available on the board.

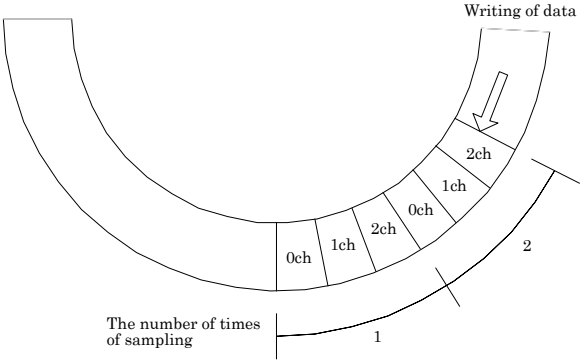
Memory

Board's or driver's input data storage memory is used to enable advanced analog input processing at high speed. For the memory, the FIFO or ring format can be selected by means of software.

- FIFO format
  In the FIFO (First In First Out) format, input data items are read from memory in the same order in which they were written to the memory. Input data items are fed out of the memory sequentially, where the oldest one is always read from the memory. The status monitor and application notification functions are provided, which check and report the state in which the memory has stored a fixed amount of data or in which the memory has become full.
  The FIFO memory is used to obtain all input data from analog input in a short or infinite period of time.

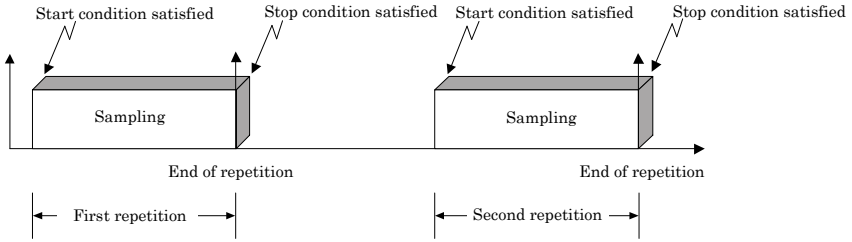


- Ring format
  In the ring format, the memory contains storage areas arranged in a ring. Input data items are written to the memory sequentially. When it stores data exceeding the limit, it overwrites the area storing the previous item of input data. The status monitor and application notification functions are provided, which check and report the state in which data has been written to certain areas of memory.
  The ring memory is used to obtain data where conversion has stopped due to some event, usually without obtaining data in the normal state.



Repeat

"Repeat" indicates the number of repetitions of sampling to be executed, from when the sampling start condition is satisfied until the end of sampling, including delayed sampling.
The number of repetitions is set by means of software, for which conversion is repeated. You can set an infinite number of repetitions, in which case the conversion is terminated by the software abort command. Input data items are stored to the memory sequentially. The repetition state can be subject to status monitoring and application notification.



This board does not support the Repeat feature when the sampling start condition is "software".

Clock

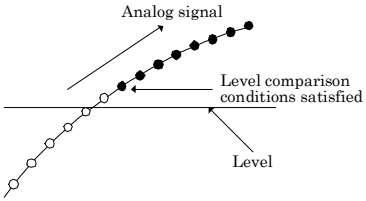
The internal or external sampling clock can be selected as the sampling clock that determines the sampling period. The sampling clock is selected by means of software.

- Internal sampling clock
  The clock signal from the on-board clock generator is used.
- External sampling clock
  The edge of the digital signal input from an external device is used for the sampling clock.

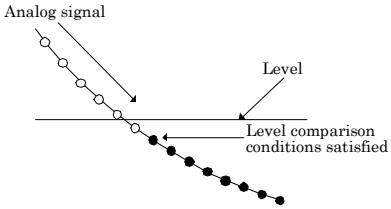
Start Condition

The condition for controlling the start of sampling can be selected from among software, input data comparison, and an external trigger. The conditions for controlling the start and stop of sampling are completely independent of each other; they can be set separately.

- Software
  The board starts sampling and storing input data to memory immediately after the operation start command is issued.
- Input data comparison
  When the operation start command is issued, the board compares the analog signal input through a specified channel to the value of the preset comparison level. If the analog signal satisfies the condition, the board starts storing input data.
  Level comparison conditions are set as two conditions: level and direction.



The above sketch shows that the level comparison condition is satisfied in the rising direction.
The start condition is satisfied when the analog signal at the specified channel passes the comparison level in the rising direction. Input data items are stored to memory, starting with those at solid dots.



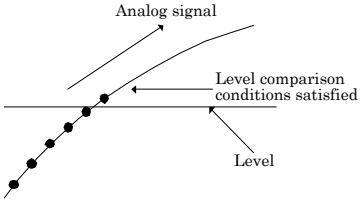
The above sketch shows that the level comparison condition is satisfied in the falling direction.
The start condition is satisfied when the analog signal at the specified channel passes the comparison level in the falling direction. Input data items are stored to memory, starting with those at solid dots.
If you set the level comparison directions to both directions, the start condition is satisfied when the analog signal passes the level both in the rising and falling directions.

- External trigger
  The board enters the external control signal wait status immediately after the operation start command is issued.
  When the external control signal in the preset edge direction (rising or falling) is input, the board starts sampling and storing input data to memory.

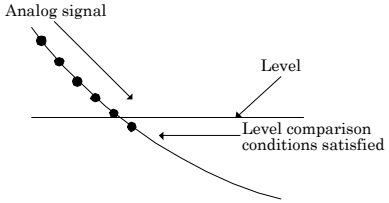
Stop Condition

The condition for controlling the stop of sampling can be selected from among the last sampling count, input data comparison, an external trigger, and software abort.
The board stops sampling whenever an error occurs irrespective of the stop condition setting.

- Last sampling count
  The board stops sampling after storing input data to memory for the specified number of times of sampling.
- Input data comparison
  Once the board has started sampling, it compares the analog signal input through a specified channel to the value of the preset comparison level. If the analog signal satisfies the condition, the board stops sampling.
  Level comparison conditions are set as two conditions: level and direction.



The above sketch shows that the level comparison condition is satisfied in the rising direction.
The stop condition is satisfied when the analog signal at the specified channel passes the comparison level in the rising direction. Input data items are stored to memory, ending until those at solid dots.

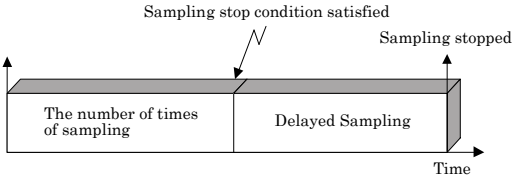


The above sketch shows that the level comparison condition is satisfied in the falling direction.
The stop condition is satisfied when the analog signal at the specified channel passes the comparison level in the falling direction. Input data items are stored to memory, ending until those at solid dots
If you set the level comparison directions to both directions, the start condition is satisfied when the analog signal passes the level both in the rising and falling directions.

- External trigger
  The board enters the external control signal wait status upon completion of sampling for the specified number of times. The board stops sampling upon reception of the external control signal in the preset edge direction (rising or falling).
- Software
  In this mode, the board continues sampling infinitely until either the software abort command is executed or an error occurs.

Delay

Delayed sampling is performed after the sampling stop condition is satisfied.
When a sampling stop condition other than the software abort command is satisfied, the board performs sampling for the specified number of times of delayed sampling to store input data to memory.
If you set the number of times of delayed sampling to 0, the board stops sampling the moment the sampling stop condition is satisfied.



Event

”Event” works as a function for reporting the occurrence of a certain board state to the application.

The following events can be used in combination depending on the purpose of usage.

- ”AD conversion start condition satisfied” event
  This event occurs when the AD conversion start condition is satisfied. The event is nullified when the conversion start condition is “software”.
- ”Repeat end” event
  This even occurs whenever a repetition is completed.
- ”End of device operation” event
  This event occurs when the entire operation including repetitions is completed.
- ”Stored specified sampling times” event
  This event occurs when sampling has been performed for the number of times set by software.
- Overflow event
  This event occurs at an attempt to store input data with the memory full.
- Sampling clock error event
  This event occurs when conversion stops as an error occurs due to a sampling clock period that is too short.
- AD conversion error event
  This event occurs when conversion stops due to an AD conversion error.

2. Starting/Stopping Operation

Sampling is started by the software command.
Once started, sampling can be stopped by the software command at any timing.

3. Monitoring the Status and Acquiring Data

Software commands are used to monitor the operation status of the device and to acquire input data from memory. Status monitoring and data acquisition can be performed even during sampling.

Status

The current state of the device can be checked by obtaining the device status.
The following types of device status are available:

- Device operating
  The “device operating” status remains ON, after the execution of the sampling start command until the board completes conversion, aborts operation due to an error, or stops sampling in response to the command.
- Waiting for start trigger
  This status remains ON, after the board starts sampling until the start trigger is input, if the conversion start condition is an external trigger or level comparison. The status is set to OFF when the input trigger is input to start conversion.
  The status is set to ON whenever the board enters the conversion start wait status even when repeated operation has been set.
- Specified sampling data stored
  This status is set to ON when input data stored in memory has reached the amount corresponding to the preset number of times of sampling.
  If the memory format is FIFO, the status is set to OFF when the amount of input data in the memory falls below the value corresponding to the preset number of times of sampling as data is acquired.
  Once the status is set to ON when the memory format is ring, it remains ON until it is reset.
- Overflow
  An overflow error occurs when an attempt is made to store input data to memory while it has been full of input data.
  When the memory format is FIFO, the board stops conversion.
  When the memory format is ring, the board continues conversion while overwriting existing data with new one.
- Sampling clock error
  This error occurs when the sampling clock period is too short.
- AD conversion error
  If the “device operating” status remains ON (without terminating conversion) for an extended period of time, the driver regards that state as an operation error and sets this status to ON. This error stops sampling.

Sampling

The number of sampled items of input data stored in memory can be obtained by the software command.

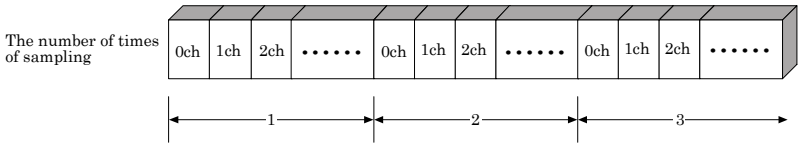
Repeat

The current repeat count can be obtained by the software command.

Data acquisition

Input data stored in memory can be acquired by the software command.

Illustrated below is the relationship between the number of times of sampling of input data stored in memory and the input channels.



Input data is acquired differently depending on the memory format used.

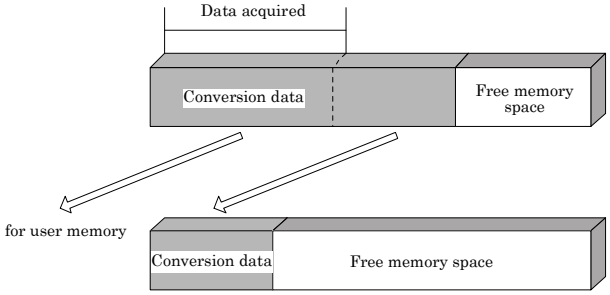
- Data acquisition in FIFO format

  When FIFO memory is used, the oldest data is always read first.

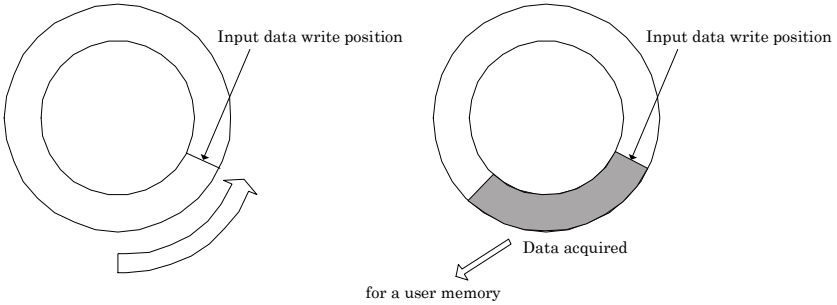
  The following sketch shows an image of data acquisition in FIFO format.

  When data is acquired from the memory, the free memory space increases by that data size. When data is acquired next, the oldest one of the existing data items is taken from the memory in the same way.

  The FIFO memory deletes data once that data is acquired.



- Data acquisition in ring format
  When ring memory is used, data is read always with respect to the current input data write position.
  The following sketch shows an image of data acquisition in ring format.
  The sampling count obtained is always the number of times of sampling for up to the latest data (shaded portion below).
  The larger the number of samples taken, the older the data item acquired first.
  As the ring memory retains data even after that data is acquired, you can fetch the same data any number of times.



Conversion data

The following equation represents the relationship between input data and voltage.

Voltage = Input data x (Max. range value – Min. range value) / Resolution + Min. range value

The value of resolution for the 12-bit device is 4096; that for the 16-bit device is 65536.

< ±10V range >

The following tables show the relationship between AD conversion data and voltage.

Voltage	Conversion data (12-bit)
+9.995V	4095
:	:
0.005V	2049
0V	2048
-0.005V	2047
:	:
-10.000V	0

Voltage	Conversion data (16-bit)
+9.99970V	65535
:	:
0.00030V	32769
0V	32768
-0.00030V	32767
:	:
-10.000V	0

Ex.: When input data 3072 is input at a resolution of 12-bit in the ± 10-volt range
Voltage = 3072 x (10 - (-10)) ÷ 4096 + (-10)
= 5.0

< 0 - 10V range >

The following tables show the relationship between AD conversion data and voltage.

Voltage	Conversion data (12-bit)
+9.998V	4095
:	:
5.002V	2049
5V	2048
4.998V	2047
:	:
0V	0

Voltage	Conversion data (16-bit)
9.99985V	65535
:	:
5.00015V	32769
5V	32768
4.99985V	32767
:	:
0V	0

Ex.: When input data 3072 is input at a resolution of 12-bit in the 0 - 10-volt range

Voltage = 3072 x (10 - 0) ÷ 4096 + 0

= 7.5

4.Reset

Various states can be reset by executing the following reset commands:

All reset

This command resets the entire device, thereby initializing the device.

Status

This command resets the sampling clock error status and AD conversion error status.

Memory

This command resets the following memory related states.

- Resets the sampling count to 0.
- Resets the “specified number of samples stored” status to OFF.
- Resets the buffer overflow status to OFF.
- Resets the repeat count to 0.

5. Extended function

Simultaneous Sampling Control

Simultaneous sampling is executing AD conversion on multiple channels at the sampling clock timing. The simultaneous sampling unit ATSS-16A available as an option provides this board with the 16-channel simultaneous sampling feature.

Channel Expansion

Using the channel expansion sub-board ATCH-16A(PCI) [for AIO-121601E3-PE and AIO-161601E3-PE] or ATUH-16A(PCI) [for AIO-161601UE3-PE and AIO-121601UE3-PE] increases the maximum number of input channels to 32 (16 channels in differential input mode).

Analog Output Function

The board converts digital data to analog signals according to the resolution.

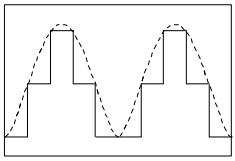
Resolution

"Resolution" signifies the number of bits used by an analog output device to represent analog signals. The higher the resolution, the more finely the voltage range is segmented, allowing the device to convert digital values to analog equivalents more precisely.

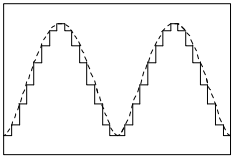
A device with a resolution of 12-bit divides the range width into 4096 segments.

When the device covers the range of 0 - 10 V, the minimum unit of converted voltages is 10÷4096 ≠ 2.44mV.

If the device has a resolution of 16-bit, it is 10 ÷ 65536 ≠ 0.153mV instead.



Low-resolution board



High-resolution board

AIO-121601E3-PE and AIO-121601UE3-PE : The resolution is 12-bit.
AIO-161601E3-PE and AIO-161601UE3-PE : The resolution is 16-bit.

Channel

"Channel" represents each point of analog output.
For individual channel numbers, see "Using the On-board Connectors" to "Connector Pin Assignment" in Chapter 3 "External Connection".
When selecting a channel, specify its channel No. or the number of channels on which you wish to perform DA conversion (consecutive channels starting from channel 0).

Range

"Range" means the range of voltages at which analog output can be performed.
The input range can be selected by setting the upper and lower output signals.

AIO-121601E3-PE : The range is specified by setting the jumpers.
AIO-161601E3-PE : The range is specified by setting the jumpers.
AIO-121601UE3-PE : The range is specified by setting the jumpers.
AIO-161601UE3-PE : The range is specified by setting the jumpers.

For details, see “Chapter 2 Setup- Setting the Hardware - Setting the Analog Output”.

Output data

Set output data to output analog signals. You can output analog signals to the specified channel or channels (from 0 to an arbitrary number of channels) by executing the software command.

The following equation represents the relationship between output data and voltage.

Output data = ((Voltage - Min. range value) x Resolution) / (Max. range value - Min. range value)

The value of resolution for the 12-bit device is 4096; that for the 16-bit device is 65536.

< ±10V range >

The following tables show the relationship between the output data and the voltage.

Voltage	Output data(12-bit)
+9.995V	4095
:	:
0.005V	2049
0V	2048
-0.005V	2047
:	:
-10.000V	0

Voltage	Output data(16-bit)
+9.99970V	65535
:	:
0.00030V	32769
0V	32768
-0.00030V	32767
:	:
-10.000V	0

Ex.: When 3V is output at a resolution of 12-bit in the ±10-volt range

Output data = (3 - (-10)) x 4096 ÷ (10 - (-10))

= 2662.4 *

* The value that can be set as output data at this time is an integer. Select "2662" or "2663" as the output data.

The analog signal corresponding to the output data contains an error as follows:

- Output data "2662" converted to: 2.9980 V
- Output data "2663" converted to: 3.0029 V

This error is a consequential error occurring when output data is obtained from an expected analog value.

< 0 - 10V range >

The following tables show the relationship between the output data and the voltage.

Voltage	Output data(12-bit)
+9.998V	4095
:	:
5.002V	2049
5V	2048
4.998V	2047
:	:
0V	0

Voltage	Output data(16-bit)
9.99985V	65535
:	:
5.00015V	32769
5V	32768
4.99985V	32767
:	:
0V	0

Ex.: When 3V is output at a resolution of 12-bit in the 0 - 10-volt range
Output data = (3 - 0) x 4096 ÷ (10 - 0)
= 1228.8 *

* The value that can be set as output data at this time is an integer. Select "1228" or "1229" as the output data.
The analog signal corresponding to the output data contains an error as follows:
- Output data "1228" converted to: 2.9980 V
- Output data "1229" converted to: 3.0005 V
This error is a consequential error occurring when output data is obtained from an expected analog value.

Digital Input Function

Input bit

Individual digital input points are called input bits.

When the number of input points of a device is 4, the bits are determined as bit 0 - bit 3.

	bit3	bit2	bit1	bit0

Input in Bits

The state 1 (ON) or 0 (OFF) of each input bit can be obtained by specifying the bit.

Input in Bytes

Individual input bits can be input in byte units.

When the number of input points of the device is 4, the individual input bits are arranged as shown below and the byte data to be input is a value between 0 and 15 depending on the states of the bits.

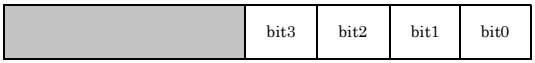
EX. Input of bit 3 (OFF), bit 2 (ON), bit 1 (OFF), and bit 0 (ON)
Byte data = 5(5H)

	bit3	bit2	bit1	bit0
	0(OFF)	1(ON)	0(OFF)	1(ON)

Digital Output Function

Output bit

Individual digital output points are called output bits.
When the number of output points of a device is 4, the bits are determined as bit 0 - bit 3.



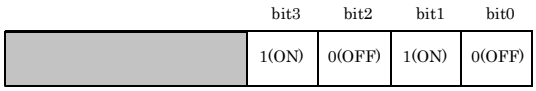
Output in Bits

The state of each output bit can be changed to ON or OFF by specifying the bit and setting it to 1 or 0.

Output in Bytes

Individual output bits can be output in byte units.
When the number of output points of the device is 4, the individual output bits are arranged as shown below and byte data to be output is a value between 0 and 15.

Ex. Output of bit 3 (ON), bit 2 (OFF), bit 1 (ON),and bit 0 (OFF)
Byte data = 10(AH)



Counter Function

The board have been equipped an independent counter that is equivalent to the i8254.
The counter has three internal 16-bit counters. These counters are connected as shown in Figure 4.1.
Changing the jumper connections can change the counter configurations.
The counter can be operated as a programmable one shot pulse or a rate generator by setting the operation mode of i8254.
The two counter outputs is set in the board register, and the status (8254 count-up status and 8254 count-overrunning status) can be confirmed by software.

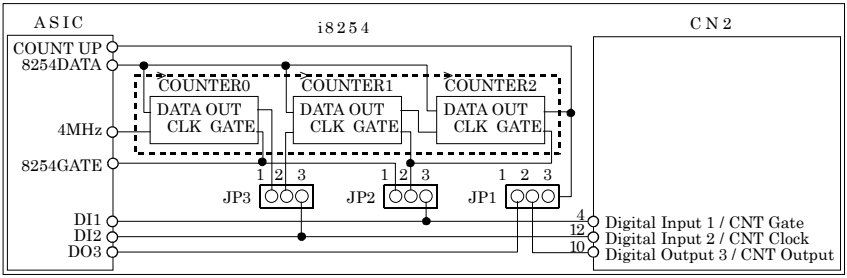
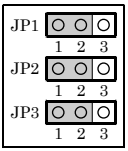
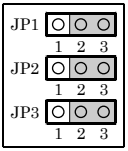


Figure 4.1. Counter Configuration

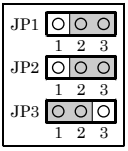


The following table shows the jumper settings.

This setting connects three counters in the cascade mode. The counter 0 clock is the on board 4MHz clock signal. The 8254GATE gate signal of the counters is controlled by software command.



This setting implements a 32-bit counter (connecting Counter 1 and Counter 2) and enables the user to control the 32-bit counter externally. The clock and the gate can be inputted from CN2, and the counter output signal be outputted from CN2 via JP1.



This setting implements a 32-bit counter (connecting Counter 1 and Counter 2) and enables the user to control only the gate. The clock uses the output of counter 0 on the basis of 4MHz. The gate can be inputted from CN2, and the output signal of the counter be outputted from CN2 via JP1.

⚠ CAUTION

- Only the TTL level signals can be used as an external control signal for the counter.
- Please refer to the data sheet of i8254 equivalent for details of the operation mode of i8254.

5. About Software

CD-ROM Directory Structure

```
\
|– Autorun.exe          Installer Main Window
|   Readmej.html        Version information on each driver (Japanese)
|   Readmeu.html        Version information on each driver (English)
   .
   .
|——APIPAC               Each installer
|       |—AIO
|       |       |—DISK1
|       |       |—DISK2
|       |       |—……
|       |       |—DISKN
|       |—AioWdm
|       |—CNT
|       |—DIO
|       |—……
   .
   .
| —HELP                 HELP file
|       |—Aio
|       |—Cnt
|       |—……
   .
   .
| —INF                  Each INF file for OS
|       |—WDM
|       |—Win2000
|       |—Win95
   .
   .
|—linux                 Linux driver file
|       |—cnt
|       |—dio
|       |—……
   .
   .
| —Readme               Readme file for each driver
   .
   .
| —Release              Driver file on each API-TOOL
|       |—API_NT        (For creation of a user-specific install program)
|       |—API_W95
   .
   .
| —UsersGuide           Hardware User's Guide (PDF files)
```

About Software for Windows

The bundled CD-ROM “Driver Library API-PAC(W32)” contains the functions that provide the following features:

- Analog input or output through arbitrary channels
- Analog input at arbitrary intervals using the internal or external sampling clock
- Simultaneous monitoring of the termination of analog input sampling, buffer memory usage, and interrupt events such as occurrences of errors
- Driver option check using a demo driver even without the board installed

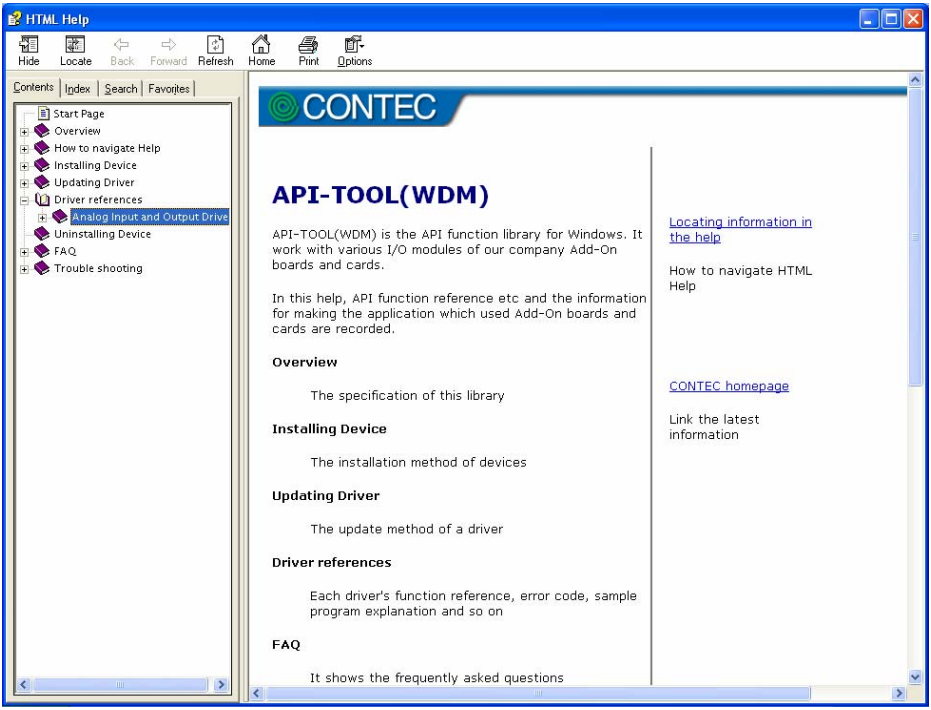
For details, refer to the help file. The help file provides various items of information such as “Function Reference”, “Sample Programs”, and “FAQs”. Use them for program development and troubleshooting.

When using the API-AIO(WDM)

Accessing the Help File

(1) Click on the [Start] button on the Windows taskbar.

(2) From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “AIOWDM” – “API-AIO(WDM) HELP” to display help information.

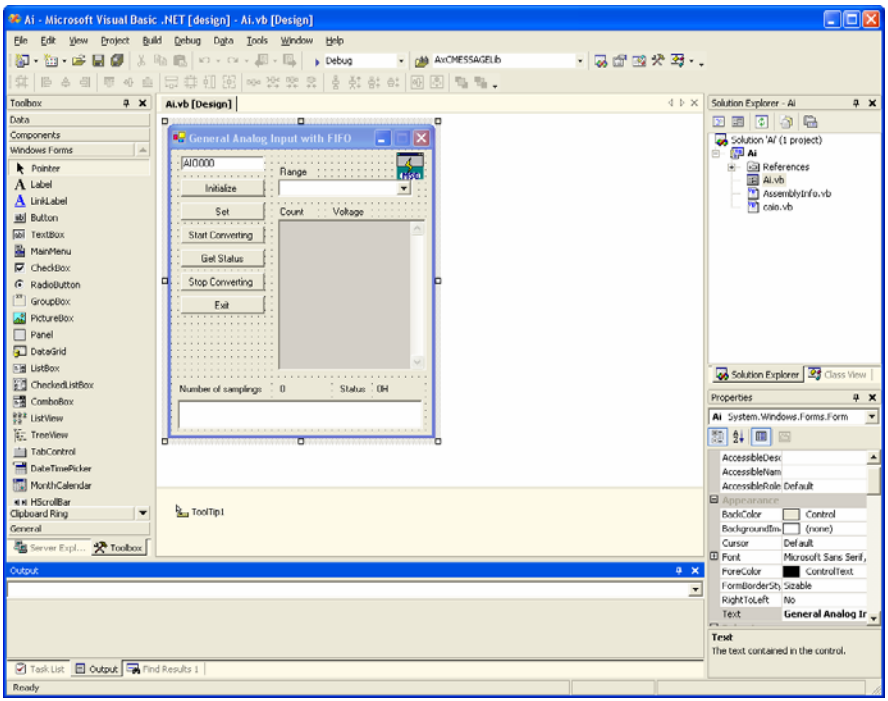


Using Sample Programs

Sample programs are provided for each of the basic operations. You can use these to check the operation of the board and as a reference when writing your own programs.

To use the sample programs, specify the device name in the property page for the program.

The sample programs are stored in \Program Files\CONTEC\API-PAC(W32)\AIOWDM\Samples.



Running a Sample Program

(1) Click on the [Start] button on the Windows taskbar.

(2) From the Start Menu, select “Programs” - “CONTEC API-PAC(W32)” - “AIOWDM” - “SAMPLE…”.

(3) A sample program is invoked.

Sample Programs - Examples

Analog input

Simple sample program

- SingleAi	Perform single analog input from specified channel
- MultiAi	Perform single analog input from multiple channels
- Ai	Perform standard analog input using a FIFO buffer
- AiPoll	Perform standard analog input by polling
- AiEx	Perform analog input for multiple channels using a FIFO buffer
- AiLong	Perform long-duration analog input using a FIFO buffer
- AiExt	Perform analog input using an external clock
- AiTrg	Perform analog input using an external trigger to start and stop operation
- AiLevel1	Use a level trigger to start analog input
- AiLevel2	Use a level trigger to stop analog input
- Ai2	Perform standard analog input using more than one device

Analog output

- SingleAo	Perform single analog output from specified channel
- MultiAo	Perform single analog output from multiple channels
- Ao	Perform standard analog output using a FIFO buffer
- AoPoll	Perform standard analog output by polling
- AoEx	Perform analog output for multiple channels using a FIFO buffer
- AoLong	Perform long-duration analog output using a FIFO buffer
- AoExt	Perform analog output using an external clock
- AoRing	Perform continuous analog output using a ring buffer
- AoTrg	Perform analog output using an external trigger to start and stop operation
- Ao2	Perform standard analog output using more than one device

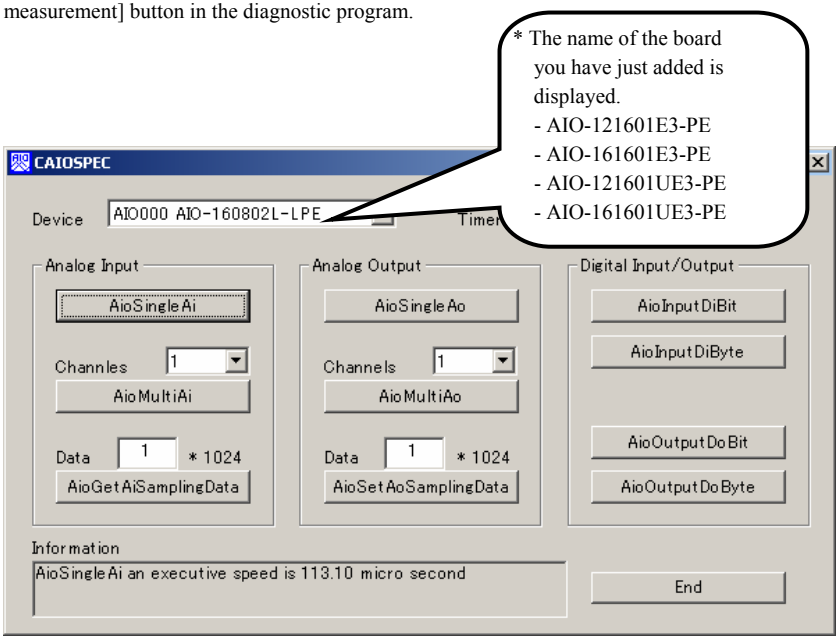
Digital input/output

- DioBit	Perform digital I/O using bit values
- DioByte	Perform digital I/O using byte values

Usage of Utility Program

Program for Measurement of Function Execution Speed

The execution time of some main functions can be measured in a function execution speed measurement program. To use a function execution speed measurement program, click the [execution time measurement] button in the diagnostic program.



Procedure

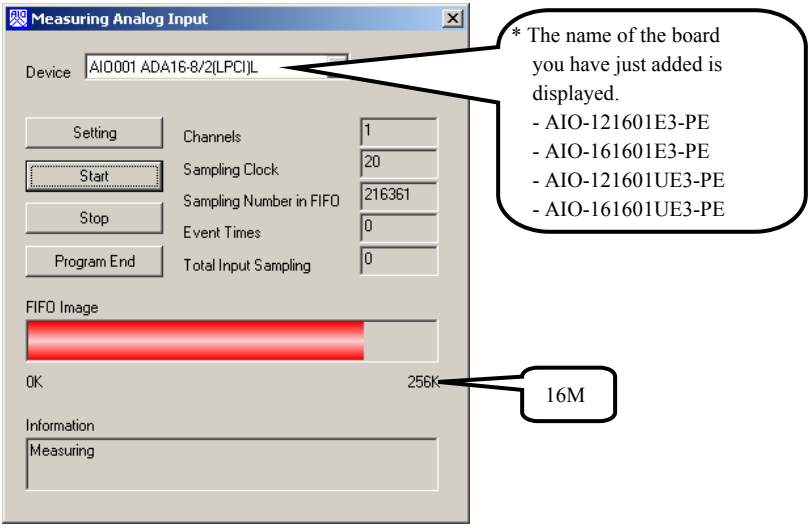
(1) Chose the measure device from device list.

(2) Click the button written with the function name to measure the execution speed of the function. Please choose from a list the number of channels used for conversion in function AioMultiAi and AioMultiAo. Input the transmission data size in function AioGetAiSamplingData and AioSetAoSamplingData. The transmission data is set by unit of kByte.

(3) End the application with an [end] button.

Analog Input Measurement Tool

It is an analog input measurement utility to carry out infinity sample in the FIFO memory. Once the conversion data of memory accumulates to a certain quantity, the event occurs and data of the memory is acquired. Data in the FIFO memory can be confirmed visually.

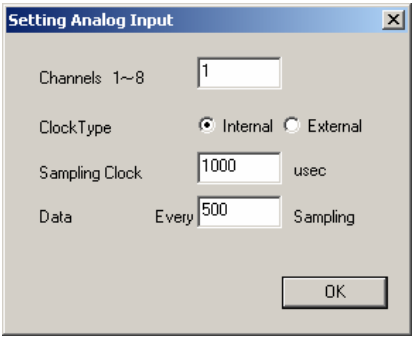


The number of channels used, the internal/external clock, the conversion speed, and the sampling frequency at which an event generates can be set. Since the notification of a sampling clock error event is sent, please make use of it for the conversion spec measurement under various conversion conditions.

Procedure

(1) Chose the device name of the device to be used from the upper left combo box, and click the setting button.

(2) The conversion conditions are set on the screen of the analog input setting.
Once an input is done at the sampling frequency specified as data taking-in sampling, an event occurs and data will be acquired. Click the OK button to finish setting the conditions, and returns to former screen.



(3) Start the measurement with measurement start button. The various states during the conversion are displayed.

The number of the samplings in FIFO is :
It is conversion data taken in the memory. This can be visually checked in a "memory image".

Event generation sampling frequency :
When the number of input sampling in FIFO reaches this frequency, the event generates.

Total input sampling frequency :
It is the total number of samplings for application in the memory.

Measurement may stop by the following errors.

Sampling clock error :
It means that the conversion speed is too fast and the driver processing is not in time when converting at the internal clock.
The cycle of the clock is too fast when converting it at the external clock. Moreover, the cause by noise etc. is also concerned.

Buffer overflow :
The memory overflows since the conversion speed is too fast compared with the one at which data is inputted.

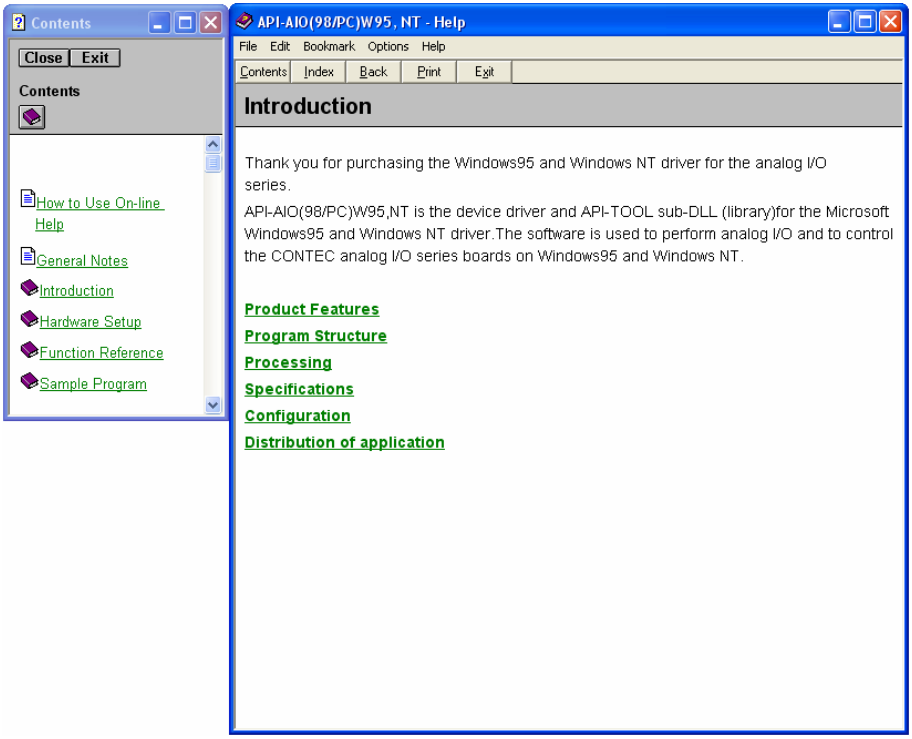
(4) Click the “stop” button, and measurement stops.

When using the API-AIO(98/PC)

Accessing the Help File

(1) Click on the [Start] button on the Windows taskbar.

(2) From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “Aio” – “API-AIO HELP” to display help information.

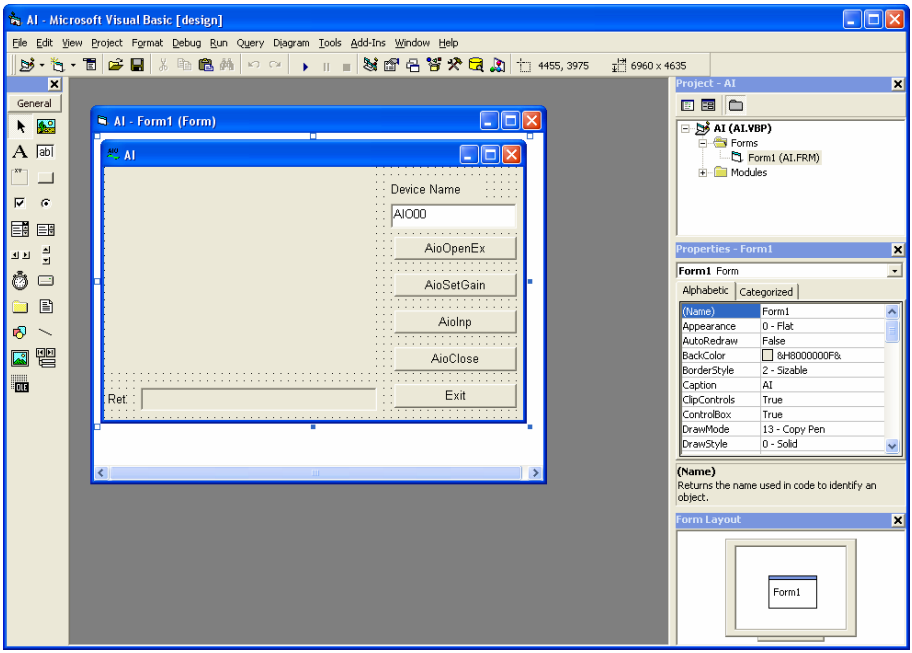

Contents
Close
Exit
Contents
How to Use On-line Help
General Notes
Introduction
Hardware Setup
Function Reference
Sample Program
API-AIO(98/PC)W95, NT - Help
File Edit Bookmark Options Help
Contents Index Back Print Exit
Introduction
Thank you for purchasing the Windows95 and Windows NT driver for the analog I/O series.
API-AIO(98/PC)W95,NT is the device driver and API-TOOL sub-DLL (library)for the Microsoft Windows95 and Windows NT driver.The software is used to perform analog I/O and to control the CONTEC analog I/O series boards on Windows95 and Windows NT.
Product Features
Program Structure
Processing
Specifications
Configuration
Distribution of application

Using Sample Programs

Sample programs have been prepared for specific basic applications.
To use each sample program, enter its device name set by API-TOOL Configuration.

Use these sample programs as references for program development and operation check.

The sample programs are stored in \Program Files\CONTEC\API-PAC(W32)\Aio\Samples.



Running a Sample Program

(1) Click on the [Start] button on the Windows taskbar.

(2) From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “Aio” – “SAMPLE…”.

(3) A sample program is invoked.

Sample Programs - Examples

Analog input

-AI	:	Uses AioInp to convert an analog signal only once and display the data.
-AIBack	:	Uses AioInpBack to perform memory-less board analog input.
-AIMemory	:	Uses AioInpBdMem to perform continuous conversion and AioReadBuf to acquire data from board memory (an example of using an external clock).
-AIInt	:	Infinite sampling example that uses AioInpBdMem for half/full interrupts and AioReadBuf to acquire data at interrupt events.
-AITimer	:	Infinite sampling example that uses AioInpBdMem to perform continuous conversion and AioReadBuf to acquire data at system timer events.
-AISync	:	Sample that uses AioInpBdMem and AioDO to perform simultaneous sampling of two memory-mounted boards.
-AioInp	:	Sample console application that uses AioOpenEx and AioInp.

Analog output

-AO	:	Uses AioOut to perform analog output once.
-AOBack	:	Uses AioOutBack to perform analog output at fixed intervals.
-AioOut	:	Sample console application that uses AioOpenEx and AioOut.

Digital input and output

-DIO	:	Uses AioDO and AioDI to perform digital input/output.

Counter

-Timer	:	Sample program using a timer. It uses the counter function to measure the lapse of time.
-Counter	:	Sample program using a counter. It uses the counter function to count external pulses.

The following sample program in Visual Basic is available.

-ANALOG	:	Versatile sample program using AioInp, AioInpBack, AioInpBdMem, AioOut, AioOutBack, AioDO, and AioDI

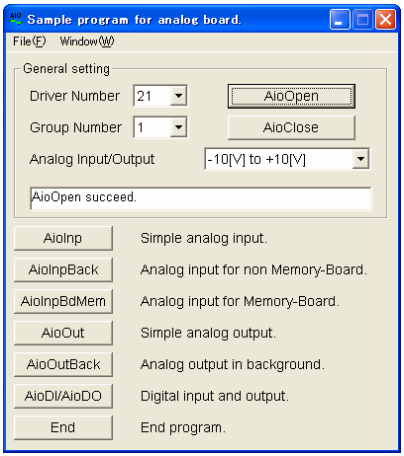
Using the Utility Program

Operation Check Tool

This program is a comprehensive operation check tool that can use all the features of the AioOpen, AioClose, AioSetRangeAioInp, AioInpBack, AioInpBdMem, AioOut, AioOutBack, AioDo, and AioDi functions.

Invoke the tool by selecting the Start Menu – "CONTEC API-PAC(W32)" – "AIO" – "SAMPLE Analog".

[Main screen]



AioInp : Simple analog input

AioInpBack : Analog input for non Memory-Board

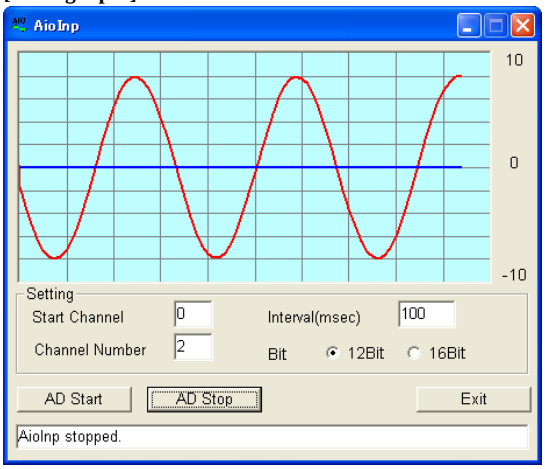
AioInpBdMem : Analog input for Memory-Board

AioOut : Simple analog output

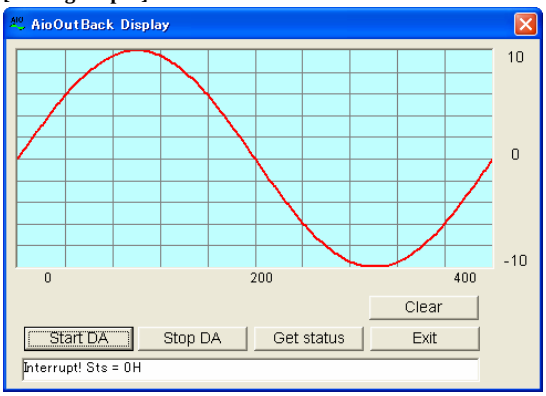
AioOutBack : Analog output in background

AioDi/AioDo : Digital input and output

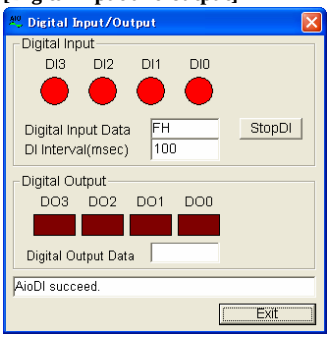
[Analog input]



[Analog output]



[Digital input and output]



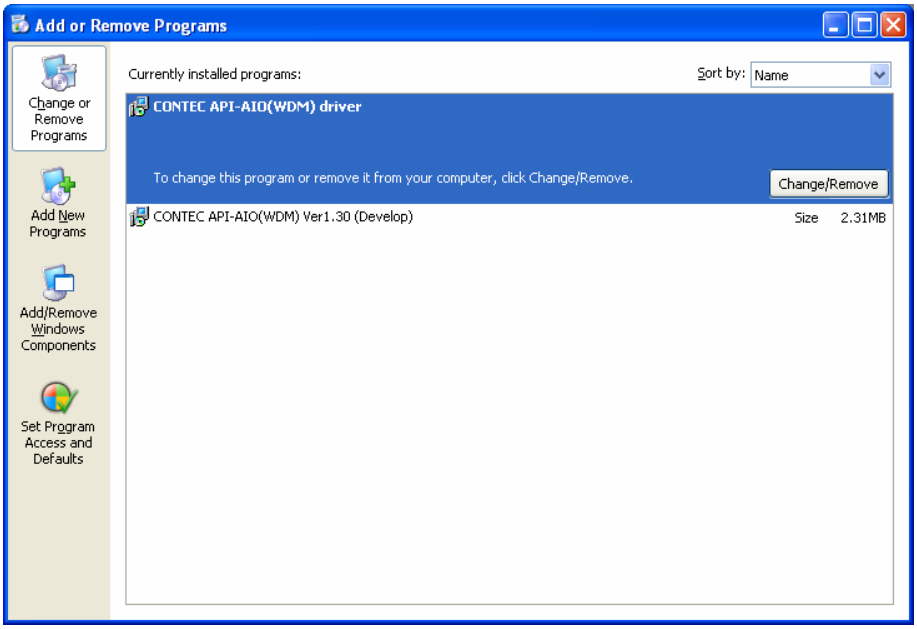
Uninstalling the Driver Libraries

To uninstall API-PAC(W32), follow the procedure below.

(1) Click on the [Start] button on the Windows taskbar. From the Start Menu, select “Settings” – “Control Panel”.

(2) Double-click on “Add or Remove Programs” in the Control Panel.

(3) Select "CONTEC API-AIO(WDM) driver" and "CONTEC API-AIO(WDM) VerX.XX (Development environment)" from the list of applications.
Click the [Change or Remove Programs] button. Proceed with uninstalling by following the instructions that appear on the screen.



About Software for Linux

The Linux version of analog I/O function driver, API-AIO(LNX), provides functions that execute the following features:

- The analog input/output of a specified channel can be done.
- It is possible to operate as a set parameter to the analog input/output board is preserved by the default value, and the setting of the parameter doesn't exist.

For details, refer to the help file. The help file provides various items of information such as “Function Reference”, “Sample Programs”, and “FAQs”. Use them for program development and troubleshooting.

Driver Software Install Procedure

The Linux version for digital I/O driver, API-AIO(LNX), is supplied as a compressed file /linux/aio/caioXXX.tgz on the bundled API-PAC(W32)CD-ROM. (Note: XXX represents the driver version.)

Mount the CD-ROM as shown below, copy the file to an arbitrary directory, and decompress the file to install the driver.

For details on using the driver, refer to readme.txt and the help file in HTML format extracted by installation.

To install the driver, log in as a superuser.

Decompression and setup procedure

```
# cd
 # mount /dev/cdrom /mnt/cdrom                Mount the CD-ROM.
 # cp /mnt/cdrom/linux/aio/caioXXX.tgz ./      Copy the compressed file.
 # tar xvfz caioXXX.tgz                       Decompress the compressed file.
 ................
 # cd contec/caio
 # make
                                              Compile the file.
 ................
 # make install                               Install.
 ................
 # cd config
 # ./config                                   Set up the board to be used.
 ..... Set as follows.........
 # ./contec_aio_start.sh                      Start the driver.
# cd
```

Accessing the Help File

(1) Invoke a web browser in your X-Window environment.

(2) In the browser, open diohelp.htm in the contec/caio/help directory.

Using Sample Programs

Sample programs have been prepared for specific basic applications.
Sample programs for each language are contained in the contec/caio/samples directory. For compiling them, refer to the manual for the desired language.

Uninstalling the driver

To uninstall the driver, use the uninstall shell script contained in the contec/caio directory. For details, check the contents of the script.

6. About Hardware

This chapter provides hardware specifications and hardware-related supplementary information.

For detailed technical information

For further detailed technical information (“Technical Reference” including the information such as an I/O map, configuration register, etc.), visit the Contec's web site (http://www.contec.com/support/) to call for it.

Hardware specification

AIO-121601E3-PE

Table 6.1. Specification *< 1 / 2 >*

Item		Specification
Analog input		
	Isolated specification	Un-Isolated
	Type	Single-Ended Input or Differential Input (Jumper setup)
	Number of input channels	16ch (Single-Ended Input) 8ch (Differential Input)
	Input range	Bipolar ±10V, ±5V, ±2.5V, ±1.25V or Unipolar 0 - +10V, 0 - +5V, 0 - +2.5V, 0 - +1.25V (Set the input range using both of jumpers and software.)
	Absolute max. input voltage	±20V
	Input impedance	1MΩ or more
	Resolution	12-bit
	Non-Linearity error *1*2	±2LSB (±10V, ±5V, ±2.5V, ±1.25V) During power-up, ±4LSB (0 - +10V, 0 - +5V, 0 - +2.5V, 0 - +1.25V) During power-up
	Conversion speed	10μ sec/ch (Max.)
	Buffer memory	16M data FIFO or16M data RING (Software setup)
	Conversion start trigger	Software/Input data comparison/TTL level external signal
	Conversion stop trigger	Specified sampling data stored /Input data comparison/ TTL level external signal/Software
Analog output		
	Isolated specification	Un-Isolated
	Number of output channels	1ch
	Output range	Bipolar ±10V / Bipolar ±5V / Unipolar 0 - +10V (Jumper setup)
	Output current ability	±5mA
	Output impedance	1Ω or less
	Resolution	12-bit
	Non-Linearity error *1	±1/2LSB
	Conversion speed	6μ sec/ch (Max.)
Digital I/O		
	Number of output channels	Un-Isolated input 4ch (TTL, Selection of a counter output is possible at a jumper.)
	Number of input channels	Un-Isolated output 4ch (TTL, A counter control input and common use are possible at a jumper.)
Counter		
	Counter device	i8254 equivalent
	Counter clock	Internal (4MHz) or External signal

Table 6.1. Specification ***< 2 / 2 >***

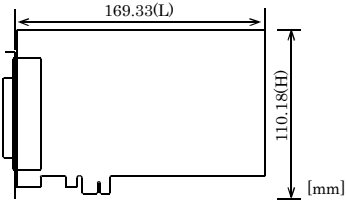
Item		Specification
I/O address		Any 32-byte boundary
Interrupt level		1 level use
Power consumption *3		+3.3V 1500 mA (Max.)
Operating condition		0 - 50°C, 10 - 90%RH (No condensation)
Bus specification		PCI Express Base Specification Rev. 1.0a x1
Physical dimensions (mm)		169.33(L) x 110.18(H)
Interface connectors		
	CN1	37 pin D-SUB connector [F (female) type] Screw lock #4-40UNC DCLC-J37SAF-20L9E [mfd. by JAE] equivalent to it
	CN2	16-pin Pin-header PS-16SEN-D4P1-1C [mfd. by JAE] equivalent to it
Weight		160g

*1: When the environment temperature is near 0ºC or 50ºC, the non-linearity error may become larger.

*2: At the time of the source use of a signal which built in the high-speed operational amplifier.

*3: If it is supplied +5VDC from the CN1 or CN2 connectors to the external device, the power consumption of this board will be bigger than what this specification has defined.

Board Dimensions



The standard outside dimension (L) is the distance from the end of the board to the outer surface of the slot cover.

AIO-161601E3-PE

Table 6.2. Specification ***< 1 / 2 >***

Item		Specification
Analog input		
	Isolated specification	Un-Isolated
	Type	Single-Ended Input or Differential Input (Jumper setup)
	Number of input channels	16ch (Single-Ended Input) 8ch (Differential Input)
	Input range	Bipolar ±10V, ±5V or Unipolar 0 - +10V, 0 - +5V (Jumper setup)
	Absolute max. input voltage	±20V
	Input impedance	1MΩ or more
	Resolution	16-bit
	Non-Linearity error *1*2*3	±5LSB
	Conversion speed	10μ sec/ch (Max.)
	Buffer memory	16M data FIFO or 16M data RING (Software setup)
	Conversion start trigger	Software/Input data comparison/TTL level external signal
	Conversion stop trigger	Specified sampling data stored /Input data comparison/ TTL level external signal/Software
Analog output		
	Isolated specification	Un-Isolated
	Number of output channel	1ch
	Output range	Bipolar ±10V / Unipolar 0 - +10V (Jumper setup)
	Output current ability	±5mA
	Output impedance	1Ω or less
	Resolution	16-bit
	Non- Linearity error *1	±3LSB
	Conversion speed	10μ sec/ch (Max.)
Digital I/O		
	Number of output channels	Un-Isolated input 4ch (TTL, Selection of a counter output is possible at a jumper.)
	Number of input channels	Un-Isolated output 4ch (TTL, A counter control input and common use are possible at a jumper.)
Counter		
	Counter device	i8254 equivalent
	Counter clock	Internal (4MHz) or External signal

Table 6.2. Specification ***< 2 / 2 >***

Item		Specification
I/O address		Any 32-byte boundary
Interrupt		1 level use
Power consumption *4		+3.3V 1500 mA (Max.)
Operating condition		0 - 50°C, 10 - 90%RH (No condensation)
Bus specification		PCI Express Base Specification Rev. 1.0a x1
Physical dimensions (mm)		169.33(L) x 110.18(H)
Interface connectors		
	CN1	37 pin D-SUB connector [F (female) type] Screw lock #4-40UNC DCLC-J37SAF-20L9E [mfd. by JAE] equivalent to it
	CN2	16-pin Pin-header PS-16SEN-D4P1-1C [mfd. by JAE] equivalent to it
Weight		160g

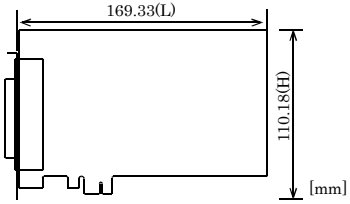
*1: When the environment temperature is near 0ºC or 50ºC, the non-linearity error may become larger.

*2: At the time of the source use of a signal which built in the high-speed operational amplifier.

*3: An error of about 0.02% of the maximum range value may occur with an un-isolated bipolar setting of ±5 V or an un-isolated unipolar setting of 0 - +5 V.

*4: If it is supplied +5VDC from the CN1 or CN2 connectors to the external device, the power consumption of this board will be bigger than what this specification has defined.

Board Dimensions



The standard outside dimension (L) is the distance from the end of the board to the outer surface of the slot cover.

AIO-121601UE3-PE

Table 6.3. Specification ***< 1 / 2 >***

Item		Specification
Analog input		
	Isolated specification	Un-Isolated
	Type	Single-Ended Input or Differential Input (Jumper setup)
	Number of input channels	16ch (Single-Ended Input) 8ch (Differential Input)
	Input range	Bipolar ±10V, ±5V, ±2.5V or Unipolar 0 - +5V, 0 - +10V (Jumper setup)
	Absolute max. input voltage	±15V
	Input impedance	1MΩ or more
	Resolution	12-bit
	Non-Linearity error *1*2	±3LSB
	Conversion speed	1μ sec/ch (Max.)
	Buffer memory	16M data FIFO or 16M data RING (Software setup)
	Conversion start trigger	Software/Input data comparison/TTL level external signal
	Conversion stop trigger	Specified sampling data stored /Input data comparison/ TTL level external signal/Software
Analog output		
	Isolated specification	Un-Isolated
	Number of output channel	1ch
	Output range	Bipolar ±10V / Bipolar ±5V / Unipolar 0 - +10V (Jumper setup)
	Output current ability	±5mA
	Output impedance	1Ω or less
	Resolution	12-bit
	Non-Linearity error *1	±1/2LSB
	Conversion speed	6μ sec/ch (Max.)
Digital I/O		
	Number of output channels	Un-Isolated input 4ch (TTL, Selection of a counter output is possible at a jumper.)
	Number of input channels	Un-Isolated output 4ch (TTL, A counter control input and common use are possible at a jumper.)
Counter		
	Counter device	i8254 equivalent
	Counter clock	Internal (4MHz) or External signal

Table 6.3. Specification ***< 2 / 2 >***

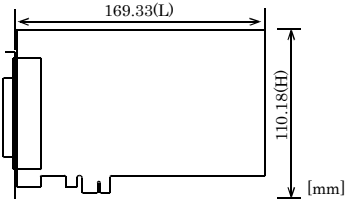
Item		Specification
I/O address		Any 32-byte boundary
Interrupt		1 level use
Power consumption *3		+3.3V 1200 mA (Max.)
Operating condition		0 - 50°C, 10 - 90%RH (No condensation)
Bus specification		PCI Express Base Specification Rev. 1.0a x1
Physical dimensions (mm)		169.33(L) x 110.18(H)
Interface connectors		
	CN1	37 pin D-SUB connector [F (female) type] Screw lock #4-40UNC DCLC-J37SAF-20L9E [mfd. by JAE] equivalent to it
	CN2	16-pin Pin-header PS-16SEN-D4P1-1C [mfd. by JAE] equivalent to it
Weight		160g

*1: When the environment temperature is near 0ºC or 50ºC, the non-linearity error may become larger.

*2: At the time of the source use of a signal which built in the high-speed operational amplifier.

*3: If it is supplied +5VDC from the CN1 or CN2 connectors to the external device, the power consumption of this board will be bigger than what this specification has defined.

Board Dimensions



The standard outside dimension (L) is the distance from the end of the board to the outer surface of the slot cover.

AIO-161601UE3-PE

Table 6.4. Specification ***< 1 / 2 >***

Item		Specification
Analog input		
	Isolated specification	Un-Isolated
	Type	Single-Ended Input or Differential Input (Jumper setup)
	Number of input channels	16ch (Single-Ended Input) 8ch (Differential Input)
	Input range	Bipolar ±10V, ±5V or Unipolar 0 - +10V, 0 - +5V (Jumper setup)
	Absolute max. input voltage	±15V
	Input impedance	1MΩ or more
	Resolution	16-bit
	Non-Linearity error *1	±3LSB
	Conversion speed	1μ sec/ch (Max.)
	Buffer memory	16M data FIFO or 16M data RING (Software setup)
	Conversion start trigger	Software/Input data comparison/TTL level external signal
	Conversion stop trigger	Specified sampling data stored /Input data comparison/ TTL level external signal/Software
Analog output		
	Isolated specification	Un-Isolated
	Number of output channel	1ch
	Output range	Bipolar ±10V / Unipolar 0 - +10V (Jumper setup)
	Output current ability	±5mA
	Output impedance	1Ω or less
	Resolution	16-bit
	Non- Linearity error *1	±3LSB
	Conversion speed	10μ sec/ch (Max.)
Digital I/O		
	Number of output channels	Un-Isolated input 4ch (TTL, Selection of a counter output is possible at a jumper.)
	Number of input channels	Un-Isolated input 4ch (TTL, A counter control input and common use are possible at a jumper.)
Counter		
	Counter device	i8254 equivalent
	Counter clock	Internal (4MHz) or External signal

Table 6.4. Specification ***< 2 / 2 >***

Item		Specification
I/O address		Any 32-byte boundary
Interrupt		1 level use
Power consumption *4		+3.3V 2000 mA (Max.)
Operating condition		0 - 50°C, 10 - 90%RH (No condensation)
Bus specification		PCI Express Base Specification Rev. 1.0a x1
Physical dimensions (mm)		169.33(L) x 110.18(H)
Interface connectors		
	CN1	37 pin D-SUB connector [F (female) type] Screw clock #4-40UNC DCLC-J37SAF-20L9E [mfd. by JAE] equivalent to it
	CN2	16-pin Pin-header PS-16SEN-D4P1-1C [mfd. by JAE] equivalent to it
Weight		160g

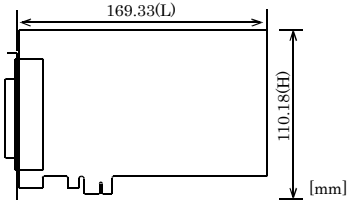
*1: When the environment temperature is near 0ºC or 50ºC, the non-linearity error may become larger.

*2: At the time of the source use of a signal which built in the high-speed operational amplifier.

*3: An error of about 0.02% of the maximum range value may occur with an un-isolated bipolar setting of ±5 V or an un-isolated unipolar setting of 0 - +5 V.

*4: If it is supplied +5VDC from the CN1 or CN2 connectors to the external device, the power consumption of this board will be bigger than what this specification has defined.

Board Dimensions



The standard outside dimension (L) is the distance from the end of the board to the outer surface of the slot cover.

Block Diagram

Figure 6.1 is a circuit block diagram of this board.

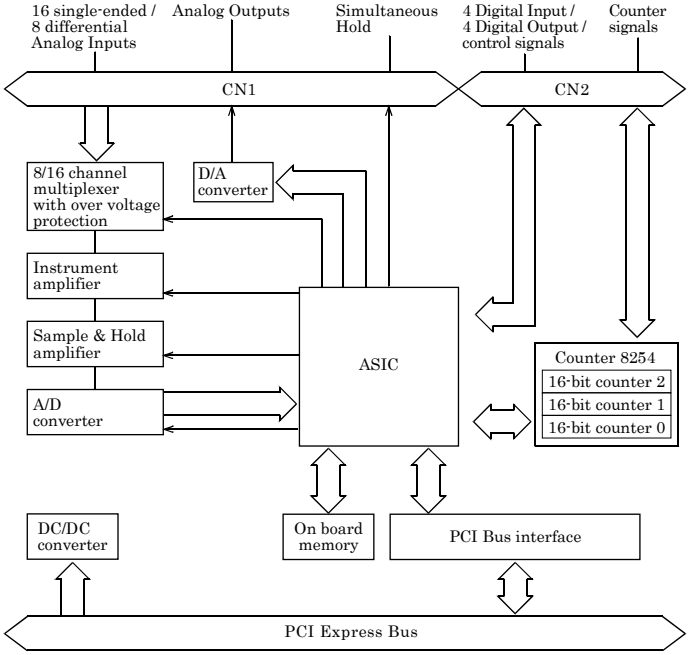


Figure 6.1. Block Diagram

Timing of Sampling Control Signals

There are timing chart diagrams and a table about sampling control signals as shown Fig.6.2 - 6.4 and Table 6.5.

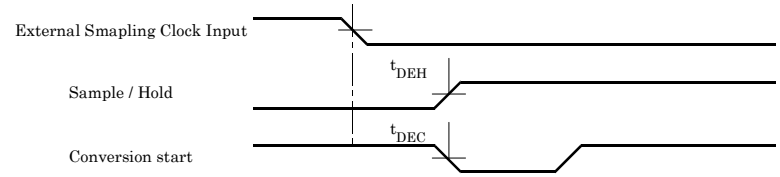


Figure 6.2. Timing Chart of External Sampling Clock

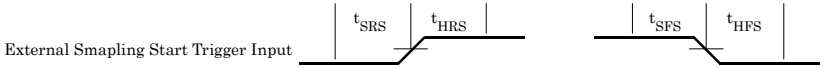


Figure 6.3. Timing Chart of External Sampling Start Trigger

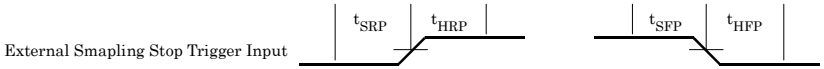


Figure 6.4. Timing Chart of External Sampling Stop Trigger

Table 6.5. Timing Table of External Control Signals

Parameter	Symbol	Typ.	Unit
Delay time from external sampling clock to first hold action	tDEH	100	nsec
Delay time from external sampling clock to first A/D start pulse	tDEC	100	nsec
Set up time of sampling start (Rising edge)	tSRS	100	nsec
Hold time of sampling start (Rising edge)	tHRS	100	nsec
Set up time of sampling start (Falling edge)	tSFS	100	nsec
Hold time of sampling start (Falling edge)	tHFS	100	nsec
Set up time of sampling stop (Rising edge)	tSRP	100	nsec
Hold time of sampling stop (Rising edge)	tHRP	100	nsec
Set up time of sampling stop (Falling edge)	tSFP	100	nsec
Hold time of sampling stop (Falling edge)	tHFP	100	nsec

⚠ CAUTION

All the model values are shown at the time of Table 6.5.

About Calibration

This board is calibrated before shipment.

Contact your retailer if the board does not provide its prescribed performance.

Differences between past analog E and this product

Based on the previous analog E series for the PCI bus, this product has been redesigned to support the PCI Express bus.
Therefore, the same usage as the E series for PCI bus can be basically done.
There are some differences in specifications as shown below.

Past E Series : AD12-16(PCI)E, AD16-16(PCI)E, AD12-16U(PCI)EH, AD16-16U(PCI)EH
AD12-16(PCI)EV, AD16-16(PCI)EV, AD12-16U(PCI)EV, AD16-16U(PCI)EV
This product : AIO-121601E3-PE, AIO-161601E3-PE, AIO-121601UE3-PE, AIO161601UE3-PE

AIO121601E3-PE, AD12-16(PCI)E and AD12-16(PCI)EV

	AIO-121601E3-PE	AD12-16(PCI)EV	AD12-16(PCI)E
I/O address	Any 32-byte boundary		Any 16-byte boundary
Analog input range	Jumper setting (The setting different from old goods)		Jumper setting
Analog output range	Jumper setting (The setting different from old goods)		Jumper setting
Buffer memory	16M data FIFO or 16M data RING *1		256K data FIFO or 256K data RING
Power consumption	+3.3V 1500mA (Max.)	+5V 1000mA (Max.)	+5V 1100mA (Max.)
External supply capable current	+5V DC from PC CN1 0.9A CN2 0.9A (CN1 + CN2)	+5V DC from PC CN1 2A CN2 1A	
Interrupt signal resource setting	Automatically set by PC		Set to select whether to use jumper JP12
Bus specification	PCI Express Base Specification Rev. 1.0a x1	PCI (32-bit, 33MHz, Universal key shapes supported)	PCI(32-bit, 33MHz, 5V key shapes supported)
Physical dimensions (mm)	169.33(L) x 110.18(H)	176.41(L) x 105.68(H)	176.41(L) x 106.68(H)

*1 It is necessary to correct the application because the capacity of the buffer memory is different when replacing it from old goods.

AIO161601E3-PE, AD16-16(PCI)EV and AD16-16(PCI)E

	AIO161601E3-PE	AD16-16(PCI)EV	AD16-16(PCI)E
I/O address	Any 32-byte boundary		Any 16-byte boundary
Analog input range	Jumper setting (The setting different from old goods)		Jumper setting
Analog output range	Jumper setting (The setting different from old goods)		Jumper setting
Buffer memory	16M data FIFO or 16M data RING *1		256K data FIFO or 256K data RING
Analog output Non- Linearity error	±3LSB		±2LSB
Power consumption	+3.3V 1500mA (Max.)	+5V 1000mA (Max.)	+5V 1100mA (Max.)
External supply capable current	+5V DC from PC CN1 0.9A CN2 0.9A (CN1 + CN2)	+5V DC from PC CN1 2A CN2 1A	
Interrupt signal resource setting	Automatically set by PC		Set to select whether to use jumper JP12
Bus specification	PCI Express Base Specification Rev. 1.0a x1	PCI (32-bit, 33MHz, Universal key shapes supported)	PCI(32-bit, 33MHz, 5V key shapes supported)
Physical dimensions (mm)	169.33(L) x 110.18(H)	176.41(L) x 105.68(H)	176.41(L) x 106.68(H)

*1 It is necessary to correct the application because the capacity of the buffer memory is different when replacing it from old goods.

AIO121601UE3-PE, AD12-16U(PCI)EV and AD12-16U(PCI)EH

	AIO121601UE3-PE	AD12-16U(PCI)EV	AD12-16U(PCI)EH
Power consumption	+3.3V 1200mA (Max.)	+5V 1000mA (Max.)	+5V 1200mA (Max.)
External supply capable current	+5V DC from PC CN1 0.9A CN2 0.9A (CN1 + CN2)	+5V DC from PC CN1 2A CN2 1A	
Bus specification	PCI Express Base Specification Rev. 1.0a x1	PCI (32-bit, 33MHz, Universal key shapes supported)	
Physical dimensions (mm)	169.33(L) x 110.18(H)	176.41(L) x 105.68(H)	176.41(L) x 106.68(H)

AIO-161601UE3-PE, AD16-16U(PCI)EV and AD16-16U(PCI)EH

	AIO-161601UE3-PE	AD16-16U(PCI)EV	AD16-16U(PCI)EH
Power consumption	+3.3V 2000mA (Max.)	+5V 1000mA (Max.)	+5V 1400mA (Max.)
External supply capable current	+5V DC from PC CN1 0.9A CN2 0.9A (CN1 + CN2)	+5V DC from PC CN1 2A CN2 1A	
Bus specification	PCI Express Base Specification Rev. 1.0a x1	PCI(PCI (32-bit, 33MHz, Universal key shapes supported)	
Physical dimensions (mm)	169.33(L) x 110.18(H)	176.41(L) x 105.68(H)	176.41(L) x 106.68(H)

AIO-121601E3-PE
AIO-161601E3-PE
AIO-121601UE3-PE
AIO-161601UE3-PE
User's Guide

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